


# 2008 VRSC Models Service Manual

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# ABOUT THIS MANUAL

## GENERAL

This Service Manual has been prepared with two purposes in mind. First, it will acquaint the user with the construction of the Harley-Davidson product and assist in the performance of basic maintenance and repair. Secondly, it will introduce to the professional Harley-Davidson Technician the latest field-tested and factory-approved major repair methods. We sincerely believe that this Service Manual will make your association with Harley-Davidson products more pleasant and profitable.

## HOW TO USE YOUR SERVICE MANUAL

Refer to the table below for the content layout of this manual.

| NO. | CHAPTER |
|---|---|
| 1 | Maintenance |
| 2 | Chassis |
| 3 | Engine |
| 4 | Fuel System |
| 5 | Starter |
| 6 | Cooling System |
| 7 | Transmission |
| 8 | Electrical |
| A | Appendix A Connector Repair |
| B | Appendix B Wiring |
| C | Appendix C ABS |
| D | Appendix D Valve Lash |
| E | Appendix E Conversions |
| F | Appendix F Glossary |

Use the TABLE OF CONTENTS (which follows this FOREWORD) and the INDEX (at the back of this manual) to quickly locate subjects. Sections and topics in this manual are sequentially numbered for easy navigation.

For example, a cross-reference shown as **2.1 SPECIFICATIONS** refers to chapter 2 CHASSIS, heading 2.1 SPECIFICATIONS.

For quick and easy reference, all pages contain a section number followed by a page number. For example, **page 3-5** refers to page 5 in section 3.

A number of acronyms and abbreviations are used in this document. See the F.1 GLOSSARY for a list of acronyms, abbreviations and definitions.

## PREPARATION FOR SERVICE

**⚠WARNING**

**Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)**

Good preparation is very important for efficient service work. A clean work area at the start of each job will allow you to perform the repair as easily and quickly as possible, and will reduce the incidence of misplaced tools and parts. A motorcycle that is excessively dirty should be cleaned before work starts.

Cleaning will occasionally uncover sources of trouble. Tools, instruments and any parts needed for the job should be gathered before work is started. Interrupting a job to locate tools or parts is a distraction and causes needless delay.

*NOTES*

- *To avoid unnecessary disassembly, carefully read all relative service information before repair work is started.*
- *In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.*
- *When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), you must first disarm the security system. Either keep the fob in close proximity to the vehicle, or use Digital Technician to disable the security system while the vehicle is being serviced and re-enable the system after service is completed.*

## SERVICE BULLETINS

In addition to the information presented in this Service Manual, Harley-Davidson Motor Company will periodically issue Service Bulletins to Harley-Davidson dealers. Service Bulletins cover interim engineering changes and supplementary information. Consult the Service Bulletins to keep your product knowledge current and complete.

## USE GENUINE REPLACEMENT PARTS

**⚠WARNING**

**Do not use aftermarket parts and custom made front forks which can adversely affect performance and handling. Removing or altering factory installed parts can adversely affect performance and could result in death or serious injury. (00001a)**

To ensure satisfactory and lasting repairs, carefully follow the Service Manual instructions and use only genuine Harley-Davidson replacement parts. Behind the emblem bearing the words GENUINE HARLEY-DAVIDSON stand more than 100 years of design, research, manufacturing, testing and inspecting experience. This is your assurance that the parts you are using will fit right, operate properly and last longer.

## WARNINGS AND CAUTIONS

Statements in this service manual preceded by the following words are of special significance.

**⚠WARNING**

**WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. (00119a)**

**⚠CAUTION**

**CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. (00139a)**

**CAUTION**

**CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage. (00140a)**

*NOTE*

*Refers to important information, and is placed in italic type. It is recommended that you take special notice of these items.*

Proper service and repair is important for the safe, reliable operation of all mechanical products. The service procedures recommended and described in this service manual are effective methods for performing service operations.

**⚠WARNING**

**Always wear proper eye protection when using hammers, arbor or hydraulic presses, gear pullers, spring compressors, slide hammers and similar tools. Flying parts could result in death or serious injury. (00496b)**

Some of these service operations require the use of tools specially designed for the purpose. These special tools should be used when and as recommended. It is important to note that some warnings against the use of specific service methods, which could damage the motorcycle or render it unsafe, are stated in this service manual. However, please remember that these warnings are not all-inclusive. Inadequate safety precautions could result in death or serious injury.

Since Harley-Davidson could not possibly know, evaluate or advise the service trade of all possible ways in which service might be performed, or of the possible hazardous consequences of each method, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Harley-Davidson must first thoroughly satisfy himself that neither his nor the operator's safety will be jeopardized as a result. Failure to do so could result in death or serious injury.

## PRODUCT REFERENCES

**⚠WARNING**

**Read and follow warnings and directions on all products. Failure to follow warnings and directions can result in death or serious injury. (00470b)**

When reference is made in this manual to a specific brand name product, tool or instrument, an equivalent product, tool or instrument may be substituted.

### Kent-Moore Products

All tools mentioned in this manual with an "HD", "J" or "B" preface must be ordered through SPX Kent-Moore. For ordering information or product returns, warranty or otherwise, visit www.spx.com.

### Loctite Sealing and Threadlocking Products

Some procedures in this manual call for the use of Loctite products. If you have any questions regarding Loctite product usage or retailer/wholesaler locations, please contact Loctite Corp. at www.loctite.com.

## PRODUCT REGISTERED MARKS

Allen, Amp Multilock, Bluetooth, Brembo, Delphi, Deutsch, Dunlop, Dynojet, Fluke, G.E. Versilube, Gunk, Hydroseal, Hylomar, Kevlar, Lexan, Loctite, Lubriplate, Keps, K&N, Magnaflux, Marson Thread-Setter Tool Kit, MAXI fuse, Molex, MPZ, Mulitilock, Novus, Packard, Pirelli, Permatex, Philips, PJ1, Pozidriv, Robinair, S100, Sems, Snap-on, Teflon, Threadlocker, Torca, Torco, TORX, Tufoil, Tyco, Ultratorch, Velcro, X-Acto, and XM Satellite Radio are among the trademarks of their respective owners.

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## CONTENTS

All photographs, illustrations and procedures may not necessarily depict the most current model or component, but are based on the latest production information available at the time of publication.

Since product improvement is our continual goal, Harley-Davidson reserves the right to change specifications, equipment or designs at any time without notice and without incurring obligation.

# MAINTENANCE

## 1.1 GENERAL


Servicing a New Motorcycle....1-1
Safe Operating Maintenance....1-1
Shop Practices....1-1
- Repair Notes....1-1
- Safety....1-1
- Removing Parts....1-1
- Cleaning....1-1
- Disassembly and Assembly....1-2
- Checking Torques on Fasteners with Lock Patches....1-2
- Magnetic Parts Trays....1-2

Repair and Replacement Procedures....1-2
- Hardware and Threaded Parts....1-2
- Threadlocking Agents....1-2
- Wiring, Hoses and Lines....1-2
- Instruments and Gauges....1-2
- Bearings....1-2
- Bushings....1-2
- Gaskets....1-2
- Lip Type Seals....1-2
- O-Rings (Preformed Packings)....1-3
- Gears....1-3
- Shafts....1-3
- Part Replacement....1-3
- Exhaust System Leakage....1-3

Cleaning....1-3
- Part Protection....1-3
- Cleaning Process....1-3
- Rust or Corrosion Removal....1-3
- Bearings....1-3

Tool Safety....1-3
- Air Tools....1-3
- Wrenches....1-3
- Pliers/Cutters/Pry bars....1-3
- Hammers....1-4
- Punches/Chisels....1-4
- Screwdrivers....1-4
- Ratchets and Handles....1-4
- Sockets....1-4
- Storage Units....1-4


## 1.2 MAINTENANCE SCHEDULE


General....1-5


## 1.3 FUEL AND OIL


Fuel....1-8
Gasoline Blends....1-8
Engine Lubrication....1-8
Winter Lubrication....1-8


## 1.4 BULB REQUIREMENTS


General....1-10


## 1.5 AIR CLEANER AND EXHAUST SYSTEM


Removal....1-11
Installation....1-12
Exhaust System Leak Check....1-13


## 1.6 RADIATOR SIDE COVERS


Removal....1-14
Installation....1-15


## 1.7 COOLING SYSTEM


Checking Coolant Level in Overflow Bottle....1-16
Check for Coolant in System....1-16


## 1.8 ENGINE OIL AND FILTER


Checking and Adding Oil....1-17
- Cold Engine Oil Level Check....1-17
- Hot Engine Oil Level Check....1-17

Changing Oil and Filter....1-18


## 1.9 BATTERY MAINTENANCE


General....1-20
Disconnection/Removal....1-21
Cleaning and Inspection....1-21
Charging Battery....1-21
- Safety Precautions....1-21
- Using a Battery Charger....1-22

Installation/Connection....1-23
Storage....1-24


## 1.10 BRAKES


Fluid Inspection....1-25
Rear Brake Pedal....1-26
- Pedal Adjustment....1-26


## 1.11 BRAKE PADS AND DISCS


Inspection....1-27
- Brake Pads....1-27
- Brake Disc Thickness....1-27
- Brake Disc Lateral Runout and Warpage....1-27

Brake Pad Replacement....1-27
- Rear Brake Caliper....1-27
- Front Brake Caliper....1-28


## 1.12 BLEEDING BRAKES


General....1-31
Procedure....1-31


## 1.13 TIRES AND WHEELS


Tires....1-33
Wheel Bearings....1-33


## 1.14 CLUTCH


General....1-34
Checking Clutch Fluid Level....1-34


## 1.15 BLEEDING CLUTCH FLUID LINE


Procedure....1-35


## 1.16 REAR BELT DEFLECTION


Inspection....1-37


## 1.17 REAR BELT AND SPROCKETS


General....1-39
Cleaning....1-39
Inspection....1-39
- Sprockets....1-39
- Rear Belt....1-39


## 1.18 DRIVE BELT REPLACEMENT


Replacement....1-41


## 1.19 DRIVE SPROCKET FLANGE


Replacement....1-43

# TABLE OF CONTENTS

## 1.20 SUSPENSION ADJUSTMENTS


Rear Shock Absorbers: VRSC Models....1-45
General....1-45
Adjustment....1-45


## 1.21 STEERING HEAD BEARINGS


Adjustment (Fall-Away)....1-46


## 1.22 SPARK PLUGS AND COIL


General....1-47
Removal/Inspection....1-47
Installation....1-48


## 1.23 CABLE, LINE AND FRAME INSPECTION


General....1-49
Cables and Hand Levers....1-49
Jiffy Stand....1-49
Fuel System Lines and Fittings....1-49
Hydraulic Lines....1-49


## 1.24 THROTTLE CABLES


Inspection....1-50
Lubrication....1-50
Adjustment....1-50


## 1.25 VALVE LASH


Lash Measurement....1-51
Camshaft Inspection....1-54
Lobe Surface Finish....1-54
Camshaft Spalling (typical)....1-54
Verify Cam Timing....1-55
Lash Adjustment....1-56


## 1.26 SECONDARY CAM CHAIN


General....1-62
Adjustment....1-62


## 1.27 HEADLAMP ALIGNMENT


Inspection....1-65
Adjustment....1-65


## 1.28 CRITICAL FASTENERS


Inspection....1-67


## 1.29 STORAGE


General....1-68
Placing in Storage....1-68
Removal from Storage....1-68


## 1.30 TROUBLESHOOTING


General....1-70
Engine....1-70
Starter Motor Does Not Operate or Does Not Turn Engine Over....1-70
Engine Turns Over But Does Not Start....1-70
Starts Hard....1-70
Starts But Runs Irregularly or Misses....1-70
Spark Plug Fouls Repeatedly....1-70
Pre-Ignition or Detonation (Knocks or Pings)....1-70
Overheating....1-71
Valve Train Noise....1-71
Excessive Vibration....1-71
Check Engine Light Illuminates During Operation....1-71
Lubrication System....1-71
Engine Uses Too Much Oil Or Smokes Excessively....1-71
Engine Leaks Oil From Cases, Hoses, Etc....1-71
Low Oil Pressure....1-71
High Oil Pressure....1-71
Electrical System....1-71
Alternator Does Not Charge....1-71
Alternator Charge Rate Is Below Normal....1-71
Speedometer Operates Erratically....1-71
Transmission....1-71
Shifts Hard....1-71
Jumps Out Of Gear....1-72
Clutch Slips....1-72
Clutch Drags Or Does Not Release....1-72
Clutch Chatters....1-72
Handling....1-72
Irregularities....1-72
Brakes....1-72
Brake Does Not Hold Normally....1-72


# CHASSIS

## 2.1 SPECIFICATIONS: CHASSIS


General....2-1


## 2.2 VEHICLE IDENTIFICATION NUMBER (V.I.N.)


Vehicle Identification Number: VRSC Models....2-3


## 2.3 FRAME AND LOWER FRAME RAILS


General....2-5
Removal....2-5
Installation....2-5


## 2.4 FRONT ENGINE MOUNT


Replacement....2-7


## 2.5 FRONT ENGINE MOUNT ASSEMBLY


Removal....2-8
Disassembly And Assembly....2-8
Installation....2-8


## 2.6 REAR ENGINE MOUNTS


Removal....2-10
Installation....2-10


## 2.7 ENGINE REPLACEMENT


General....2-11
Removal....2-11
Installation....2-16


## 2.8 FOOTRESTS AND FOOT CONTROLS: FORWARD MOUNT


Rider Footrests....2-19
Removal....2-19
Installation....2-19

## 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT

Rider Footrests....2-21
Rider Left Side Footrest and Control Removal....2-21
Rider Left Side Footrest and Control Installation....2-21
Rider Right Side Footrest and Control Removal....2-21
Rider Right Side Footrest and Control Installation....2-22

## 2.10 PASSENGER FOOTRESTS

Passenger Footrests....2-23
Removal....2-23
Installation....2-23

## 2.11 THROTTLE CABLES

Removal/Disassembly....2-24
Cleaning And Inspection....2-24
Assembly and Installation....2-24

## 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR

General....2-26
Removal....2-26
Disassembly....2-26
Assembly....2-27
Installation....2-28

## 2.13 CLUTCH HAND LEVER

Removal....2-29
Installation....2-29

## 2.14 CLUTCH FLUID LINE

Removal....2-30
Installation....2-30

## 2.15 SECONDARY CLUTCH ACTUATOR

Removal....2-31
Assembly....2-31
Installation....2-31

## 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR

General....2-33
Removal and Disassembly....2-33
Cleaning and Inspection....2-35
Assembly....2-35
Installation....2-35

## 2.17 FRONT BRAKE CALIPER

Removal....2-37
Installation....2-37

## 2.18 REAR BRAKE MASTER CYLINDER AND RESERVOIR: FORWARD CONTROLS

Removal....2-39
Disassembly....2-41
Cleaning and Inspection....2-41
Assembly....2-41
Installation....2-42

## 2.19 REAR BRAKE RESERVOIR: MID-MOUNT CONTROLS

Removal....2-43
Installation....2-43

## 2.20 REAR BRAKE MASTER CYLINDER: MID-MOUNT CONTROLS

Removal....2-44
Disassembly....2-44
Cleaning and Inspection....2-46
Assembly....2-46
Installation....2-46

## 2.21 REAR BRAKE CALIPER

Removal....2-48
Installation....2-48

## 2.22 HANDLEBARS: VRSCAW

Removal....2-49
Installation....2-50

## 2.23 HANDLEBARS: ALL EXCEPT VRSCAW

Removal....2-51
Installation....2-51

## 2.24 FRONT WHEEL

General....2-53
Preliminary Inspection - Brake Discs....2-53
Preliminary Inspection - Wheel/Tire....2-53
Removal....2-54
Disassembly....2-55
Cleaning and Inspection....2-56
Assembly....2-56
Installation....2-57

## 2.25 WHEEL LACING

Procedure....2-58

## 2.26 TRUING LACED WHEELS

General....2-62
Lateral Truing....2-62
Radial Truing....2-62

## 2.27 REAR WHEEL

General....2-64
Preliminary Inspection - Brake Disc....2-64
Preliminary Inspection - Wheel/Tire....2-64
Removal....2-65
Disassembly....2-66
Cleaning and Inspection....2-67
Assembly....2-67
Installation....2-67

## 2.28 SEALED WHEEL BEARINGS

General....2-69
Inspection: Lateral End Play....2-69
Removal....2-69
Installation....2-70

# TABLE OF CONTENTS


## 2.29 DISC RIM RUNOUT

General....2-72
Lateral Runout....2-72
Radial Runout....2-72

## 2.30 TIRES

General....2-73
Removal....2-73
Cleaning, Inspection, and Repair....2-73
Tire Replacement....2-73
Inspection....2-73
When To Replace Tires....2-73
Installation....2-74

## 2.31 WHEEL ALIGNMENT

General....2-75
Inspection....2-75
Front Engine Mount....2-75
Rear Engine Mounts and Swingarm Pivot....2-75
Engine Stabilizer Link....2-75
Clearances....2-75
Verification....2-75
Centering Engine....2-76

## 2.32 FRONT FENDER

Removal....2-78
Installation....2-78

## 2.33 FRONT FORK

Removal....2-79
Disassembly....2-79
Cleaning and Inspection....2-80
Assembly....2-82
Installation....2-83

## 2.34 STEERING HEAD

Removal....2-84
Cleaning and Inspection....2-85
Lower Fork Stem Bearing....2-85
Steering Head Bearing Race....2-85
Assembly....2-86
Installation....2-86

## 2.35 FORK LOCK

General....2-87
Removal....2-87
Installation....2-87

## 2.36 BELT GUARD AND DEBRIS DEFLECTOR

Removal....2-88
Belt Guard....2-88
Debris Deflector....2-88
Installation....2-88
Belt Guard....2-88
Debris Deflector....2-88

## 2.37 REAR SHOCK ABSORBERS

Removal....2-89
Installation....2-89

## 2.38 SWINGARM

Removal....2-91
Disassembly and Assembly....2-92
General....2-92
Left Side Swingarm Bearing Removal....2-93
Left Side Swingarm Bearing Installation....2-93
Right Side Bushing Removal....2-93
Right Side Bearing Installation....2-94
Installation....2-94

## 2.39 SEAT

Removal....2-96
Cleaning and Inspection....2-96
Installation....2-96

## 2.40 REAR FENDER

Removal....2-98
Installation....2-98

## 2.41 JIFFY STAND

Cleaning....2-99
Jiffy Stand Interlock: International Models....2-99
Removal....2-99
Installation....2-100

# ENGINE

## 3.1 SPECIFICATIONS: ENGINE

General....3-1

## 3.2 SERVICE WEAR LIMITS

General....3-5

## 3.3 HOW TO USE THIS SECTION

Top End Repair....3-7
Bottom End Repair....3-7
Typical Symptoms....3-7

## 3.4 OIL FLOW

General....3-8

## 3.5 OIL PRESSURE

Oil Pressure Indicator Lamp....3-12
Checking Oil Pressure....3-12

## 3.6 TROUBLESHOOTING

Compression Test....3-13
Diagnosing Valve Train Noise....3-13
Cylinder Leakage Test....3-13
Diagnosing Smoking Engine or High Oil Consumption....3-14
Check Prior to Cylinder Head Removal....3-14
Check After Cylinder Head Removal....3-14

## 3.7 STRIPPING MOTORCYCLE FOR SERVICE

General....3-15
Engine Cradle and Stand....3-15

### 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING

General....3-17
Removal....3-17
Camshaft Inspection....3-20
Lobe Surface Finish....3-20
Camshaft Spalling....3-21
Primary Cam Drive Removal....3-22
Primary Cam Drive Installation....3-23
Installation of Cams, Timing Chains and Camshaft Timing....3-25

### 3.9 CYLINDER HEAD

Removal....3-34
Disassembly....3-35
Valve Seat Refacing....3-41
Head Assembly....3-42
Installation....3-44

### 3.10 UPPER AND LOWER CRANKCASE SEPARATION

Disassembly....3-46

### 3.11 ENGINE BOTTOM END SERVICE

Crankshaft, Piston and Cylinder Liner Removal/Installation....3-50

### 3.12 OIL PUMP

Oil Pump....3-64

### 3.13 OIL FILTER MOUNT

Removal/Installation....3-66

## FUEL SYSTEM

### 4.1 SPECIFICATIONS: FUEL SYSTEM

General....4-1

### 4.2 ELECTRONIC FUEL INJECTION (EFI)

Troubleshooting....4-2

### 4.3 FUEL TANK

Removal....4-3
Cleaning and Inspecting....4-4
Installation....4-4

### 4.4 THROTTLE POSITION SENSOR (TP)

General....4-5
Removal....4-5
Installation....4-5

### 4.5 INTAKE AIR TEMPERATURE SENSOR (IAT)

General....4-6
Removal....4-6
Installation....4-6

### 4.6 ENGINE COOLANT TEMPERATURE SENSOR (ECT)

General....4-8
Removal....4-8
Installation....4-8

### 4.7 THROTTLE BODY AND FUEL RAIL

Removal....4-10
Installation....4-10

### 4.8 IDLE AIR CONTROL (IAC)

General....4-13
Removal....4-13
Installation....4-13

### 4.9 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP)

Removal....4-14
Installation....4-14

### 4.10 OXYGEN SENSOR

Oxygen Sensor....4-15
Front Sensor Removal....4-15
Rear Sensor Removal....4-15
Oxygen Sensor....4-16
Front Sensor Installation....4-16
Rear Sensor Installation....4-16

### 4.11 FUEL INJECTORS

General....4-18
Removal....4-18
Disassembly....4-18
Fuel Injectors....4-18
Fuel Pressure Regulator....4-18
Fuel Tubes....4-18
Assembly....4-18
Fuel Injectors....4-18
Fuel Pressure Regulator....4-18
Fuel Tubes....4-19
Installation....4-19

### 4.12 FUEL PUMP/FILTER/SENDER ASSEMBLY

Removal....4-20
Installation....4-21
Suction Side Fuel Filter....4-22
Pressure Side Fuel Filter....4-22
Removal....4-22
Installation....4-22
Fuel Pump....4-22
General....4-22
Removal....4-22
Installation....4-22
Fuel Level Sensor....4-24
Removal....4-24
Installation....4-24

### 4.13 FUEL PRESSURE TEST

General....4-25
Testing....4-25

# TABLE OF CONTENTS


### 4.14 EXHAUST SYSTEM: VRSCAW

Removal....4-27
Installation....4-29

### 4.15 EXHAUST SYSTEM: VRSCD

Removal....4-30
Installation....4-31
Exhaust Pipes....4-32
  Removal....4-32
  Installation....4-33
Mufflers....4-33
  Removal....4-33
  Installation....4-33

### 4.16 EXHAUST SYSTEM: VRSCDX

Removal....4-35
Installation....4-36

### 4.17 VAPOR VALVE

General....4-38
Replacement....4-38

### 4.18 INTAKE LEAK TEST

General....4-39
Leak Tester....4-39
  Parts List....4-39
  Tester Assembly....4-39
  Tester Adjustment....4-39
Procedure....4-39
  ....4-39

### 4.19 EVAPORATIVE EMISSIONS CONTROL (CA MODELS)

General....4-41
Purge Solenoid....4-41
  Removal....4-41
  Installation....4-42
Carbon Canister....4-42
  Removal/Inspection....4-42
  Installation....4-42
Tube Routing/Replacement....4-42

## STARTER

### 5.1 SPECIFICATIONS: STARTER

General....5-1

### 5.2 STARTER SYSTEM

General....5-2
  Wiring Diagrams....5-2
  Starter Relay....5-2
  Starter....5-2
  Starter Solenoid....5-2
Operation....5-2

### 5.3 STARTER RELAY

Removal....5-4
Installation....5-4

### 5.4 STARTER

Removal....5-5
Installation....5-5

### 5.5 STARTER SOLENOID

General....5-6
Removal....5-6
Installation....5-6

## COOLING SYSTEM

### 6.1 SPECIFICATIONS: COOLING SYSTEM

General....6-1

### 6.2 COOLANT FLOW

General....6-2
Flow Description....6-2
Troubleshooting....6-2
  Low Engine Temperature....6-2
  High Engine Temperature....6-2
  Coolant Leaks....6-2
Pressure Cap....6-2
Pressure Cap Test....6-3
System Pressure Test....6-4
Leak Detection Dye Test....6-4
Tests for Blown Gasket....6-5

### 6.3 ENGINE COOLANT

General....6-6
Replacing Coolant....6-6

### 6.4 THERMOSTAT

General....6-8
Removal....6-8
Installation....6-8

### 6.5 WATER PUMP

Removal....6-10
Installation....6-11

### 6.6 COOLANT PIPES AND HOSES

Removal....6-13
Disassembly....6-13
Assembly....6-15
Installation....6-15

### 6.7 OIL LINE FITTINGS

General....6-16
Removal....6-16
Installation....6-17

### 6.8 RADIATOR AND OIL COOLER

General....6-18
Removal....6-18
Installation....6-20

### 6.9 OIL COOLER

Removal....6-23
Installation....6-23

# TRANSMISSION

## 7.1 SPECIFICATIONS: TRANSMISSION

General....7-1

## 7.2 CLUTCH

Removal....7-2
Disassembly....7-6
Cleaning and Inspection....7-6
Assembly....7-7
Installation....7-10

## 7.3 TRANSMISSION

Disassembly....7-13
Shift Drum Removal....7-14
Assembly....7-16

## 7.4 COUNTERBALANCER BEARING REPLACEMENT

Removal....7-25
Installation....7-28

## 7.5 SHIFT SHAFT AND SEAL

General....7-32
Removal....7-32
Installation....7-33

## 7.6 OUTPUT SHAFT

General....7-34
Disassembly - 2nd Gear End....7-34
Bearing Removal - 2nd Gear End....7-34
Bearing Installation - 2nd Gear End....7-35
Assembly - 2nd Gear End....7-39
Bearing Removal - 1st Gear End....7-39
Bearing Installation - 1st Gear End....7-40
Assembly - 1st Gear End....7-41

## 7.7 INPUT SHAFT

Disassembly - 2nd Gear End....7-44
Bearing Removal - 2nd Gear End....7-44
Bearing Installation - 2nd Gear End....7-44
Assembly - 2nd Gear End....7-47
Disassembly - 1st Gear End....7-48
Bearing Removal - 1st Gear End....7-49
Assembly - 1st Gear End....7-49
Bearing Installation - 1st Gear End....7-49

# ELECTRICAL

## 8.1 SPECIFICATIONS: ELECTRICAL

General....8-1

## 8.2 ELECTRONIC CONTROL MODULE (ECM)

General....8-2
Removal....8-2
Installation....8-2

## 8.3 RELAY AND FUSE BLOCK

General....8-3
Relay/Fuse Block Removal....8-3
Fuse Replacement....8-3
Relay Replacement....8-3
Relay/Fuse Block Installation....8-3

## 8.4 MAXI-FUSE

General....8-5
Replacement....8-5

## 8.5 VOLTAGE REGULATOR

General....8-6
Removal....8-6
Installation....8-6

## 8.6 IGNITION/HEADLAMP KEY SWITCH

General....8-8
Replacement....8-8

## 8.7 HEADLAMP: VRSCAW

General....8-9
Headlamp Bulb....8-9
Removal....8-9
Installation....8-10

## 8.8 HEADLAMP: VRSCD/VRSCDX

General....8-11
Headlamp Bulb....8-11
Removal....8-11
Installation....8-11

## 8.9 TAIL LAMP

Removal....8-13
Installation....8-13

## 8.10 TURN SIGNALS AND RUNNING LIGHTS

Bulb Replacement....8-15
Lamp Replacement....8-15
General....8-15
Front Turn Signals....8-15
Rear Turn Signals....8-16

## 8.11 TURN SIGNAL SECURITY MODULE (TSSM)

General....8-17
Removal....8-17
Installation....8-17

## 8.12 CRANK POSITION SENSOR (CKP)

General....8-18
Removal....8-18
Installation....8-18

## 8.13 ALTERNATOR

General....8-19
Removal....8-19
Disassembly....8-20
Assembly....8-21
Installation....8-21

# TABLE OF CONTENTS


## 8.14 INSTRUMENT CLUSTER: VRSCAW

General....8-23
Removal....8-23
Installation....8-24

## 8.15 INSTRUMENT CLUSTER: VRSCD/VRSCDX

General....8-25
Removal....8-25
Installation....8-25

## 8.16 VEHICLE SPEED SENSOR (VSS)

General....8-26
Removal....8-26
Installation....8-26

## 8.17 NEUTRAL SWITCH

General....8-27
Removal....8-27
Installation....8-27

## 8.18 OIL PRESSURE SWITCH

General....8-28
Removal....8-28
Installation....8-28

## 8.19 STOPLIGHT SWITCH: FORWARD MOUNT CONTROLS

General....8-29
Removal....8-29
Installation....8-29

## 8.20 STOPLIGHT SWITCH: MID-MOUNT CONTROLS

General....8-30
Removal....8-30
Installation....8-30

## 8.21 HORN

Inspection....8-31
Replacement....8-31

## 8.22 COOLING FANS

General....8-33
Removal....8-33
Disassembly....8-33
Assembly....8-34
Installation....8-34

## 8.23 HANDLEBAR SWITCH ASSEMBLIES

General....8-35
Repair Procedures....8-35

## 8.24 RIGHT HANDLEBAR SWITCH

Removal....8-36
Installation....8-36
Disassembly....8-38
Switch Repair/Replacement....8-39
- Upper Housing Repair....8-39
- Lower Housing Repair....8-40
- Turn-Right Signal Switch....8-40
- Front Stoplight Switch....8-40

Assembly....8-41

## 8.25 LEFT HANDLEBAR SWITCH

Removal....8-42
Installation....8-42
Disassembly....8-43
Switch Repair/Replacement....8-43
- Upper Housing Repair....8-43
- Lower Housing Repair....8-44
- Turn-Left Signal Switch....8-44
- Clutch Interlock Switch....8-44

Assembly....8-44

# APPENDIX A CONNECTOR REPAIR

## A.1 AMP 1-PLACE CONNECTORS

AMP 1-Place Connector Repair....A-1
- General....A-1
- Separating Pin and Socket Housings....A-1
- Mating Pin and Socket Housings....A-1
- Removing Socket Terminals....A-1
- Installing Socket Terminal....A-1
- Removing Pin Terminal....A-1
- Installing Pin Terminal....A-2

## A.2 AMP MULTILOCK CONNECTORS

AMP Multilock Connector Repair....A-3
- General....A-3
- Separating Pin and Socket Housings....A-3
- Mating Pin and Socket Housings....A-3
- Removing Terminals from Housing....A-3
- Inserting Terminals into Housing....A-4
- Preparing Wire Leads for Crimping....A-4
- Crimping Terminals to Leads....A-5
- Inspecting Crimped Terminals....A-6

## A.3 AUTOFUSE ELECTRICAL CONNECTOR

General....A-7
Autofuse Connector Repair....A-7
- General....A-7
- Disassembly....A-7
- Assembly....A-7

Assembly....A-7

## A.4 DELPHI CONNECTORS

Delphi Connector Repair....A-8
- General....A-8
- Separating Pin and Socket Housings....A-8
- Mating Pin and Socket Housings....A-8
- Removing Socket Terminals....A-8
- Installing Socket Terminals....A-8

## A.5 DELPHI MAXI-FUSE HOUSING

Delphi Maxi-Fuse Housing Repair....A-10
- General....A-10
- Removing Maxi-Fuse....A-10
- Installing Maxi-Fuse....A-10
- Removing Socket Terminals....A-10

Installing Socket Terminals....A-10

## A.6 DEUTSCH 1-PLACE ELECTRICAL CONNECTORS

Deutsch 1-Place Connector Repair....A-12
Separating Pin and Socket Housings....A-12
Mating Pin and Socket Housings....A-12
Removing Socket Terminals....A-12
Installing Socket Terminals....A-12

## A.7 DEUSCH ELECTRICAL CONNECTORS

Deutsch Connector Repair....A-13
General....A-13
Separating Pin and Socket Housings....A-13
Mating Pin and Socket Housings....A-13
Removing Socket Terminals....A-13
Installing Socket Terminals....A-13
Removing Pin Terminals....A-15
Installing Pin Terminals....A-15
Crimping Terminals....A-16

## A.8 DEUTSCH MINI-TERMINAL CRIMPS

Deutsch Mini Terminal Crimps....A-17
Preparing Wire Leads for Crimping....A-17
Crimping a Mini Terminal to Wire Lead....A-17
Inspecting Crimps....A-17

## A.9 DEUTSCH STANDARD TERMINALS

Deutsch Standard Terminal Crimps....A-18
Preparing Wire Leads for Crimping....A-18
Crimping Terminal to Lead....A-18
Inspecting Crimps....A-18

## A.10 DEUTSCH SOLID BARREL TERMINALS

Deutsch Solid Barrel Terminal Crimps....A-19
Preparing Wire Leads For Crimping....A-19
Adjusting Crimper Tool....A-19
Crimping a Barrel Contact To Wire Lead....A-19
Inspecting Crimps....A-19

## A.11 MOLEX CONNECTORS

Molex Connector Repair....A-21
Separating Pin and Socket Housings....A-21
Mating Pin and Socket Housings....A-21
Removing Terminals....A-21
Installing Terminals....A-21
Crimp Terminal to Lead....A-22
Prepare Lead....A-22
Prepare Tool....A-22
Position Terminal in the Punch/Die....A-23
Insert Stripped Lead....A-23
Crimp Terminal to Lead....A-23
Inspect Crimp....A-24

## A.12 PACKARD 150 METRI-PACK CONNECTORS

150 Metri-Pack Connector Repair....A-25
General....A-25
Separating Pin and Socket Housings....A-25
Mating Pin and Socket Housings....A-25
Removing Socket Terminal....A-25
Inserting Socket Terminal....A-25

## A.13 PACKARD 280 METRI-PACK RELAY AND FUSE BLOCK CONNECTORS

Fuse Block Repair....A-27
Removing Socket Terminals....A-27
Installing Socket Terminals....A-27
Crimping Terminals....A-27

## A.14 PACKARD 480 METRI-PACK CONNECTORS

480 Metri-Pack Connector Repair....A-28
General....A-28
Separating Pin and Socket Housings....A-28
Mating Pin and Socket Housings....A-28
Removing Socket Terminals....A-28
Installing Socket Terminals....A-28

## A.15 PACKARD 630 METRI-PACK CONNECTORS

630 Metri-Pack Connector Repair....A-29
General....A-29
Separating Pin and Socket Housings....A-29
Mating Pin and Socket Housings....A-29
Removing Socket Terminal....A-29
Installing Socket Terminal....A-29

## A.16 PACKARD METRI-PACK TERMINALS

Metri-Pack Terminal Crimps....A-30
Matching Terminal To Crimper....A-30
Preparing Wire Lead....A-30
Crimping Wire Core....A-30
Crimping Insulation/Seal....A-30
Inspecting Crimps....A-31

## A.17 PACKARD ECM CONNECTOR

Packard 100W Connector Repair....A-32
General....A-32
Separating Socket Housing From ECM....A-32
Mating Socket Housing To ECM....A-32
Removing Socket Terminal....A-32
Installing Socket Terminal....A-32
Crimping Terminals....A-32

## A.18 PACKARD MICRO-64 CONNECTORS

Packard Micro-64 Connector Repair....A-34
General....A-34
Separating Pin and Socket Housings....A-34
Mating Pin and Socket Housings....A-34
Removing Terminal....A-34
Installing Terminal....A-34
Preparing Wire Leads for Crimping....A-35
Crimping Terminals....A-35
Inspecting Crimps....A-35

## A.19 SEALED SPLICE CONNECTORS

Sealed Splice Connector Repair....A-37
General....A-37
Preparing Wire Leads....A-37
Splicing Wire Leads....A-37

Inspecting Seals....A-37

## APPENDIX B WIRING

### B.1 CONNECTORS

Connector Locations....B-1
Function/Location....B-1
Place and Color....B-1
Connector Number....B-1
Repair Instructions....B-1

### B.2 WIRING DIAGRAMS

Wiring Diagram Information....B-3
Wire Color Codes....B-3
Wiring Diagram Symbols....B-3
2008 VRSC Wiring Diagrams....B-4

## APPENDIX C ABS

### C.1 ABS MODULE

Removal....C-1
Installation....C-2

### C.2 WHEEL SPEED SENSOR

Front Wheel Speed Sensor....C-3
Removal....C-3
Installation....C-3
Rear Wheel Speed Sensor....C-4
Removal....C-4
Installation....C-4

### C.3 ABS BRAKE LINES

Front Master Cylinder to ABS Module....C-5
Removal....C-5
Installation....C-5
ABS Module to Front Brake Calipers....C-5
Removal....C-5
Installation....C-6
Rear Master Cylinder to ABS Module....C-7
Removal....C-7
Installation....C-7
ABS Module to Rear Brake Caliper....C-8
Removal....C-8
Installation....C-9

## APPENDIX D VALVE LASH

### D.1 VALVE TAPPET SHIMS

Tables....D-1

### D.2 VALVE LASH CALCULATION WORKSHEET 1

Worksheet 1....D-2

### D.3 VALVE LASH CALCULATION WORKSHEET 2

Worksheet 2....D-3

## APPENDIX E CONVERSIONS

### E.1 LENGTH CONVERSION

Conversion Table....E-1

### E.2 FLUID CONVERSION

United States System....E-2
Metric System....E-2
British Imperial System....E-2

### E.3 TORQUE CONVERSION

United States System....E-3
Metric System....E-3

## APPENDIX F GLOSSARY

### F.1 GLOSSARY

Acronyms and Abbreviations....F-1

## REFERENCE MATERIAL

**TOOLS....I**

**TORQUE VALUES....IX**

**INDEX....XXI**

| SUBJECT | PAGE NO. |
|---|---|
| 1.1 GENERAL | 1-1 |
| 1.2 MAINTENANCE SCHEDULE | 1-5 |
| 1.3 FUEL AND OIL | 1-8 |
| 1.4 BULB REQUIREMENTS | 1-10 |
| 1.5 AIR CLEANER AND EXHAUST SYSTEM | 1-11 |
| 1.6 RADIATOR SIDE COVERS | 1-14 |
| 1.7 COOLING SYSTEM | 1-16 |
| 1.8 ENGINE OIL AND FILTER | 1-17 |
| 1.9 BATTERY MAINTENANCE | 1-20 |
| 1.10 BRAKES | 1-25 |
| 1.11 BRAKE PADS AND DISCS | 1-27 |
| 1.12 BLEEDING BRAKES | 1-31 |
| 1.13 TIRES AND WHEELS | 1-33 |
| 1.14 CLUTCH | 1-34 |
| 1.15 BLEEDING CLUTCH FLUID LINE | 1-35 |
| 1.16 REAR BELT DEFLECTION | 1-37 |
| 1.17 REAR BELT AND SPROCKETS | 1-39 |
| 1.18 DRIVE BELT REPLACEMENT | 1-41 |
| 1.19 DRIVE SPROCKET FLANGE | 1-43 |
| 1.20 SUSPENSION ADJUSTMENTS | 1-45 |
| 1.21 STEERING HEAD BEARINGS | 1-46 |
| 1.22 SPARK PLUGS AND COIL | 1-47 |
| 1.23 CABLE, LINE AND FRAME INSPECTION | 1-49 |
| 1.24 THROTTLE CABLES | 1-50 |
| 1.25 VALVE LASH | 1-51 |
| 1.26 SECONDARY CAM CHAIN | 1-62 |
| 1.27 HEADLAMP ALIGNMENT | 1-65 |
| 1.28 CRITICAL FASTENERS | 1-67 |
| 1.29 STORAGE | 1-68 |
| 1.30 TROUBLESHOOTING | 1-70 |

# NOTES

## SERVICING A NEW MOTORCYCLE

**WARNING**

**Perform the service and maintenance operations as indicated in the regular service interval table. Lack of regular maintenance at the recommended intervals can affect the safe operation of your motorcycle, which could result in death or serious injury. (00010a)**

Service operations to be performed before customer delivery are specified in the applicable model year PREDELIVERY AND SET-UP MANUAL.

The performance of new motorcycle initial service is required to keep warranty in force and to ensure proper emissions systems operation. See 1.2 MAINTENANCE SCHEDULE.

## SAFE OPERATING MAINTENANCE

*NOTES*

- *Do not attempt to retighten engine head bolts. Retightening can cause engine damage.*
- *During the initial break-in period, use only Harley-Davidson 20W50 engine oil. Failure to use the recommended oil will result in improper break-in of the engine cylinders and piston rings.*

A careful check of certain equipment is necessary after periods of storage, and frequently between regular service intervals, to determine if additional maintenance is required.

Check:

1. Tires for abrasions, cuts and correct pressure.
2. Secondary drive belt for proper tension and condition.
3. Brakes, steering and throttle for responsiveness.
4. Brake fluid level and condition. Hydraulic lines and fittings for leaks. Also, check brake pads and rotors for wear.
5. Cables for fraying, crimping and free operation.
6. Engine oil and transmission fluid levels.
7. Headlamp, auxiliary lamp, tail lamp, brake lamp, horn and turn signal operation.

## SHOP PRACTICES

### Repair Notes

General maintenance practices are given in this section.

*NOTES*

- *Repair = Disassembly/Assembly.*
- *Replacement = Substitute a **new** part for existing component.*

All special tools and torque values are noted at the point of use.

All required parts or materials can be found in the appropriate PARTS CATALOG.

### Safety

Safety is always the most important consideration when performing any job. Be sure you have a complete understanding of the task to be performed. Use common sense. Use the proper tools. Protect yourself and bystanders with approved eye protection. Don't just do the job - do the job safely.

### Removing Parts

Always consider the weight of a part when lifting. Use a hoist whenever necessary. Do not lift heavy parts by hand. A hoist and adjustable lifting beam or sling are needed to remove some parts. The lengths of chains or cables from the hoist to the part should be equal and parallel and should be positioned directly over the center of the part. Be sure that no obstructions will interfere with the lifting operation. Never leave a part suspended in mid-air.

**WARNING**

**Be sure to check capacity rating and condition of hoists, slings, chains and cables before use. Exceeding capacity ratings or using lifting devices that are in poor condition can lead to an accident, which could result in death or serious injury. (00466c)**

Always use blocking or proper stands to support the part that has been hoisted. If a part cannot be removed, verify that all bolts and attaching hardware have been removed. Check to see if any parts are in the way of the part being removed.

When removing hoses, wiring or tubes, always tag each part to ensure proper installation.

### Cleaning

If you intend to reuse parts, follow good shop practice and thoroughly clean the parts before assembly. Keep all dirt out of parts; the unit will perform better and last longer. Seals, filters and covers are used in this vehicle to keep out environmental dirt and dust. These items must be kept in good condition to ensure satisfactory operation.

When you are instructed in a step to clean fastener threads or threaded holes, proceed as follows: Clean all LOCTITE material from fastener threads and threaded holes. Use a wire brush to clean fastener threads. Use a thread chaser or other suitable tool to clean threaded holes. Use PJ-1 cleaner or equivalent to remove all traces of oil and contaminants from threads. Blow out all threaded holes with low pressure compressed air.

Clean and inspect all parts as they are removed. Be sure all holes and passages are clean and open. After cleaning, cover all parts with clean lint-free cloth, paper or other material. Be sure the part is clean when it is installed.

Always clean around lines or covers before they are removed. Plug, tape or cap holes and openings to keep out dirt, dust and debris.

Always verify cleanliness of blind holes before assembly. Tightening a screw with dirt, water or oil in the hole can cause castings to crack or break.

## Disassembly and Assembly

Always assemble or disassemble one part at a time. Do not work on two assemblies simultaneously. Be sure to make all necessary adjustments. Recheck your work when finished. Be sure that everything is done.

Operate the vehicle to perform any final check or adjustments. If all is correct, the vehicle is ready to go back to the customer.

## Checking Torques on Fasteners with Lock Patches

To check the torque on a fastener that has a lock patch:

1. Set the torque wrench for the lowest setting in the specified torque range.
2. Attempt to tighten fastener to set torque. If fastener does not move and lowest setting is satisfied (torque wrench clicks), then the proper torque has been maintained.

## Magnetic Parts Trays

Magnetic parts trays are becoming common in the service facility because they are convenient and can keep parts from becoming lost during a repair procedure.

However, hardened steel parts can become magnetized when held in magnetic parts trays. Metal fragments that would ordinarily be washed away in the oil and trapped in the oil filter or magnetic drain plug during vehicle operation could be captured by magnetized parts in the engine, potentially causing accelerated engine wear and damage.

Parts that will be returned to service inside the vehicle's powertrain such as gears, thrust washers and especially bearings should never be kept in magnetic parts trays.

# REPAIR AND REPLACEMENT PROCEDURES

## Hardware and Threaded Parts

Install helical thread inserts when inside threads in castings are stripped, damaged or not capable of withstanding specified torque.

Replace bolts, nuts, studs, washers, spacers and small common hardware if missing or in any way damaged. Clean up or repair minor thread damage with a suitable tap or die.

Replace all damaged or missing lubrication fittings.

Use Teflon pipe sealant or LOCTITE 565 THREAD SEALANT on pipe fitting threads.

## Threadlocking Agents

Always follow specific service manual procedures when working with fasteners containing preapplied threadlocking agents when fastener replacement is recommended. When re-using fasteners containing threadlocking agents, be sure to completely remove all existing threadlocking agent from fastener threads with a wire brush or wire wheel. Also, be sure to remove residual threadlocking agent from fastener hole using an appropriate thread chasing device and compressed air when using new or existing fasteners. Always use the recommended threadlocking agent for your specific procedure.

## Wiring, Hoses and Lines

Hoses, clamps, electrical wiring, electrical switches or fuel lines if they do not meet specifications.

## Instruments and Gauges

Replace broken or defective instruments and gauges. Replace dials and glass that are so scratched or discolored that reading is difficult.

## Bearings

Anti-friction bearings must be handled in a special way. To keep out dirt and abrasives, cover the bearings as soon as they are removed from the package.

Wash bearings in a non-flammable cleaning solution. Knock out packed lubricant inside by tapping the bearing against a wooden block. Wash bearings again. Cover bearings with clean material after setting them down to dry. Never use compressed air to dry bearings.

Coat bearings with clean oil. Wrap bearings in clean paper.

When bearings are installed against shoulders, be sure that the chamfered side of the bearing always faces the shoulder. Lubricate bearings and all metal contact surfaces before pressing into place. Only apply pressure on the part of the bearing that makes direct contact with the mating part. Install bearings with numbered side facing out.

Always use the proper tools and fixtures for removing and installing bearings.

Bearings do not usually need to be removed. Only remove bearings if necessary.

## Bushings

Do not remove a bushing unless damaged, excessively worn or loose in its bore. Press out bushings that must be replaced.

When pressing or driving bushings, be sure to apply pressure in line with the bushing bore. Use a bearing/bushing driver or a bar with a smooth, flat end. Never use a hammer to drive bushings.

Inspect the bushing and the mated part for oil holes. Be sure all oil holes are properly aligned.

## Gaskets

Always discard gaskets after removal. Replace with **new** gaskets. Never use the same gasket twice. Be sure that gasket holes match up with holes in the mating part. But be aware that sections of a gasket may be used to seal passages.

If a gasket must be made, be sure to cut holes that match up with the mating part. Serious damage can occur if any flange holes are blocked by the gasket. Use material that is the right type and thickness.

## Lip Type Seals

Lip seals are used to seal oil or grease and are usually installed with the sealing lip facing the contained lubricant. Seal orientation, however, may vary under different applications.

Seals should not be removed unless necessary. Only remove seals if required to gain access to other parts or if seal damage or wear dictates replacement.

Leaking oil or grease usually means that a seal is damaged. Replace leaking seals to prevent overheated bearings.

Always discard seals after removal. Do not use the same seal twice.

### O-Rings (Preformed Packings)

Always discard o-rings after removal. Replace with **new** o-rings. To prevent leaks, lubricate the o-rings before installation. Apply the same type of lubricant as that being sealed. Be sure that all gasket, o-ring and seal mating surfaces are thoroughly clean before installation.

### Gears

Always check gears for damaged or worn teeth.

Remove burrs and rough spots with a honing stone or crocus cloth before installation.

Lubricate mating surfaces before pressing gears on shafts.

### Shafts

If a shaft does not come out easily, check that all nuts, bolts or retaining rings have been removed. Check to see if other parts are in the way before using force.

Shafts fitted to tapered splines should be very tight. If shafts are not tight, disassemble and inspect tapered splines. Discard parts that are worn. Be sure tapered splines are clean, dry and free of burrs before putting them in place. Press mating parts together tightly.

Clean all rust from the machined surfaces of new parts.

### Part Replacement

Always replace worn or damaged parts with **new** parts.

### Exhaust System Leakage

In the event of an exhaust system leak at a muffler or header pipe connection location, disassemble and clean all mating surfaces. Replace any damaged components. If leak still exists, disassemble and repair the leak by applying a bead of Harley-Davidson High-Performance Sealant (Part No. 99650-02) (or an equivalent 02 Sensor/Catalyst-safe alternative). Reassemble components, wipe off any excess sealant and allow adequate curing time following sealant product instructions before operating vehicle.

## CLEANING

### Part Protection

Before cleaning, protect rubber parts (such as hoses, boots and electrical insulation) from cleaning solutions. Use a grease-proof barrier material. Remove the rubber part if it cannot be properly protected.

### Cleaning Process

Any cleaning method may be used as long as it does not result in parts damage. Thorough cleaning is necessary for proper parts inspection. Strip rusted paint areas to bare metal before priming and repainting.

### Rust or Corrosion Removal

Remove rust and corrosion with a wire brush, abrasive cloth, sand blasting, vapor blasting or rust remover. Use buffing crocus cloth on highly polished parts that are rusted.

### Bearings

Remove shields and seals from bearings before cleaning. Clean bearings with permanent shields and seals in solution.

**⚠WARNING**

**Using compressed air to "spin dry" bearings can cause bearing to fly apart, which could result in death or serious injury. (00505b)**

Clean open bearings by soaking them in a petroleum cleaning solution. Never use a solution that contains chlorine.

Let bearings stand and dry. Do not dry with compressed air. Do not spin bearings while they are drying.

## TOOL SAFETY

### Air Tools

- Always use approved eye protection equipment when performing any task using air-operated tools.
- On all power tools, use only recommended accessories with proper capacity ratings.
- Do not exceed air pressure ratings of any power tools.
- Bits should be placed against work surface before air hammers are operated.
- Disconnect the air supply line to an air hammer before attaching a bit.
- Never point an air tool at yourself or another person.
- Protect bystanders with approved eye protection.

### Wrenches

- Never use an extension on a wrench handle.
- If possible, always pull on a wrench handle and adjust your stance to prevent a fall if something lets go.
- Never cock a wrench.
- Never use a hammer on any wrench other than a STRIKING FACE wrench.
- Discard any wrench with broken or battered points.
- Never use a pipe wrench to bend, raise or lift a pipe.

### Pliers/Cutters/Pry bars

- Plastic- or vinyl-covered pliers handles are not intended to act as insulation. Do not use on live electrical circuits.
- Do not use pliers or cutters for cutting hardened wire unless they were designed for that purpose.
- Always cut at right angles.
- Do not use any pry bar as a chisel, punch or hammer.

## Hammers

- Never strike a hammer against a hardened object, such as another hammer.
- Always grasp a hammer handle firmly, close to the end.
- Strike the object with the full face of the hammer.
- Never work with a hammer which has a loose head.
- Discard hammer if face is chipped or mushroomed.
- Wear approved eye protection when using striking tools.
- Protect bystanders with approved eye protection.

## Punches/Chisels

- Never use a punch or chisel with a chipped or mushroomed end; dress mushroomed chisels and punches with a file.
- Hold a chisel or a punch with a tool holder if possible.
- When using a chisel on a small piece, clamp the piece firmly in a vise and chip toward the stationary jaw.
- Wear approved eye protection when using these tools.
- Protect bystanders with approved eye protection.

## Screwdrivers

- Do not use a screwdriver for prying, punching, chiseling, scoring or scraping.
- Use the right type of screwdriver for the job; match the tip to the fastener.
- Do not interchange POZIDRIV, PHILLIPS or REED AND PRINCE screwdrivers.
- Screwdriver handles are not intended to act as insulation. Do not use on live electrical circuits.
- Do not use a screwdriver with rounded edges because it will slip. Redress with a file.

## Ratchets and Handles

- Periodically clean and lubricate ratchet mechanisms with a light grade oil. Do not replace parts individually; ratchets should be rebuilt with the entire contents of service kit.
- Never hammer or put a pipe extension on a ratchet or handle for added leverage.
- Always support the ratchet head when using socket extensions, but do not put your hand on the head or you may interfere with the action of its reversing mechanism.
- When breaking loose a fastener, apply a small amount of pressure as a test to be sure the ratchet's gear wheel is engaged with the pawl.

## Sockets

- Never use hand sockets on power or impact wrenches.
- Select the right size socket for the job.
- Never cock any wrench or socket.
- Select only impact sockets for use with air or electric impact wrenches.
- Replace sockets showing cracks or wear.
- Keep sockets clean.
- Always use approved eye protection when using power or impact sockets.

## Storage Units

- Do not open more than one loaded drawer at a time. Close each drawer before opening up another.
- Close lids and lock drawers and doors before moving storage units.
- Do not pull on a tool cabinet; push it in front of you.
- Set the brakes on the locking casters after the cabinet has been rolled to your workspace.

## GENERAL

The table below lists the periodic maintenance requirements for VRSC model motorcycles. If you are familiar with the procedures, just refer to the table for the recommended service interval. If necessary, see the quick reference table (Table 1-2.) for the required specifications.

If more detailed information is needed, turn to the sections which follow for step-by-step instructions.

Also, throughout this manual, you will be instructed to use various lubricants, greases and sealants. Refer to Table 1-3. for the correct part numbers of these items.

**Table 1-1. Regular Service Intervals: 2008 VRSC Models**

| ITEM SERVICED | PROCEDURE | 1000 MI. 1600 KM | 5000 MI. 8000 KM | 10,000 MI. 16,000 KM | 15,000 MI. 24,000 KM | 20,000 MI. 32,000 KM | 25,000 MI. 40,000 KM | NOTES |
|---|---|---|---|---|---|---|---|---|
| Engine oil and filter | Replace | X | X | X | X | X | X | |
| Oil lines and brake system | Inspect for leaks | X | X | X | X | X | X | 1 |
| Air cleaner | Inspect, service as required | X | X | X | X | X | X | |
| Tires | Check pressure, inspect tread | X | X | X | X | X | X | |
| Clutch fluid | Check level and condition | X | X | X | X | X | X | |
| Rear belt and sprockets | Inspect, adjust belt | X | X | X | X | X | X | 1 |
| Throttle, brake and clutch controls | Check, adjust and lubricate | X | X | X | X | X | X | 1 |
| Jiffy stand | Inspect and lubricate | X | X | X | X | X | X | 1 |
| Brake fluid | Check levels and condition | X | X | X | X | X | X | 5 |
| Brake pads and discs | Inspect for wear | X | X | X | X | X | X | |
| Spark plugs | Inspect | | X | | X | | X | |
| | Replace | | | X | | X | | |
| Electrical equipment and switches | Check operation | X | X | X | X | X | X | |
| Front fork oil | | Replace every 80,000 kilometers (50,000 miles) | | | | | | 1 |
| Steering head bearings | Adjust | X | | | | X | | 1, 2 |
| Valve lash | | Adjust valve lash every 24,000 kilometers (15,000 miles) | | | | | | 1, 4 |
| Cooling system | Inspect; check clamps for tightness, check coolant freeze point | X | | X | | X | | 1 |
| Coolant | | Replace every 48,000 kilometers (30,000 miles) | | | | | | 1 |
| Radiator | Clean | X | X | X | X | X | X | |
| Critical fasteners | Check tightness | X | | X | | X | | 1 |
| Battery | Check battery and clean connections | | | | | | | 3 |
| Exhaust system | Inspect for leaks, cracks, and loose or missing fasteners or heat shields | X | X | X | X | X | X | 3 |
| Road test | Verify component and system functions | X | X | X | X | X | X | |
| **NOTES:** | 1. Should be performed by an authorized Harley-Davidson dealer, unless you have the proper tools, service data and are mechanically qualified.<br>2. Disassemble, lubricate and inspect every 48,000 kilometers (30,000 miles).<br>3. Perform annually.<br>4. Could vary with frequency of operation and riding style.<br>5. Change D.O.T. 4 and flush brake system every two years. | | | | | | | |

**Table 1-2. Quick Reference Maintenance Chart**

| ITEM SERVICED | SPECIFICATION | DATA |
|---|---|---|
| Engine oil and filter | Drain plug torque | 35 Nm (25.8 ft-lbs) |
| | Oil capacity | 5.0 qt. (4.7 L) with filter |
| | Oil Level | Bike upright, unscrew dipstick, wipe off and screw back in. Unscrew and verify level. |
| | Filter | Hand tighten 2/3-1 full turn after gasket contact |
| | Black filter part number | 63793-01K |

**Table 1-2. Quick Reference Maintenance Chart**

| ITEM SERVICED | SPECIFICATION | DATA |
|---|---|---|
| Radiator and coolant | Drain plug torque | 2.3-2.8 Nm (21-24 **in-lbs**) |
| | System capacity | 2.54 qt. (2.4 L) |
| Clutch adjustment | Free play at adjuster screw | Hydraulic |
| | Bleeder Screw Torque | 9-11 Nm (80-100 **in-lbs**) |
| | Free play at hand lever | 4 mm (5/32 in.) |
| | Clutch inspection cover torque | 6-10 Nm (53-88 **in-lbs**) |
| Transmission lubricant | Lubricant level | Wet sump engine with integral transmission, wet clutch. See engine oil. |
| Tire condition and pressure | Pressure for solo rider | Front: 2.5 bar (36 psi)<br>Rear (180mm): 2.5 bar (36 psi)<br>Rear (240mm): 2.6 bar (38 psi) |
| | Pressure for rider and passenger | Front: 2.6 bar (38 psi)<br>Rear (180mm): 2.9 bar (42 psi)<br>Rear (240mm): 2.76 bar (38 psi) |
| | Wear | Replace tire if 0.8 mm (1/32 in.) or less of tread pattern remains |
| Steering head bearings | Lubricant for steering head bearings | SPECIAL PURPOSE GREASE Part No. 99857-97 (14 oz. cartridge) |
| Brake fluid reservoir level | D.O.T. 4 hydraulic brake fluid | 99953-99A (12 oz.) |
| | Proper fluid level front | 5 mm (13/64 in.) from the top |
| | Proper fluid level rear | 12.7 mm (0.5 in.) below gasket surface |
| | Master cylinder reservoir cover torque | 0.8-1.2 Nm (7-11 **in-lbs**) |
| Brake pad linings and discs | Minimum brake pad thickness | Wear indicator lines in pad material must be visible |
| | Minimum brake disc thickness | 4.5 mm (0.177 in.) |
| Drive belt | Upward measurement force applied at midpoint of top belt strand | 4.5 kg (10 lb.) |
| | Belt deflection with no rider on motorcycle | 8 mm (0.315 in.) |
| Air cleaner | Air cleaner velocity stack screw torque | 6 Nm (53 **in-lbs**) |
| | Air cleaner cover wing nut torque | Turn wing nut 2.5-3 turns after contact |
| Throttle cables | Lubricant | SUPER OIL Part No. 94968-85TV (1/4 fl. oz.) |
| | Handlebar clamp screw torque | 6.8-9.0 Nm (60-80 **in-lbs**) |
| | Handlebar switch housing screw torque | 4-5 Nm (35-45 **in-lbs**) |
| Spark plugs | Type | 10R12A |
| | Gap | 0.89 mm (0.035 in.) |
| | Torque | 23 Nm (17 ft-lbs) with anti-seize applied to threads |
| Engine idle speed | Idle speed | 1250 RPM (Japan 1,400) |
| Front fork oil | Type | HYDRAULIC FORK OIL (TYPE E) Part No. 99884-80 (16 oz.) |
| Battery | Lubricant | ELECTRICAL CONTACT LUBRICANT Part No. 99861-02 (1 oz.) |
| | Battery terminal torque | 6.8-10.9 Nm (60-96 **in-lbs**) |

**Table 1-3. Lubricants, Greases, Sealants**

| ITEM | PART NUMBER | PACKAGE |
|---|---|---|
| Anti-Seize Lubricant | 98960-97 | 1 oz squeeze tube |
| CCI #20 Brake Grease | 42830-05 (included in master cylinder rebuild kit) | squeeze packet |
| D.O.T. 4 Brake Fluid | 99953-99A | 12 oz. bottle |
| Electrical Contact Lubricant | 99861-02 | 1 oz squeeze tube |
| Genuine Harley-Davidson Formula+ Transmission and Primary Chaincase Lubricant | 99851-05 | 1 qt bottle |
| G40M Brake Grease | 42820-04 | squeeze packet |
| Gray High Performance Sealant | 99650-02 | 1.9 oz squeeze tube |
| HYLOMAR Gasket and Thread Sealant | 99653-85 | 3.5 oz tube |
| Loctite Pipe Sealant With Teflon 565 | 99818-97 | 6 ml squeeze tube |
| Loctite Prism Primer (770) | | |
| Loctite Prism Superbonder (411) | | |
| Loctite Superbonder 420 Adhesive | | |
| Loctite Threadlocker 243 (blue) | 99642-97 | 6 ml squeeze tube |
| Loctite Threadlocker 262 (red) | 94759-99 | 6 ml squeeze tube |
| Loctite Threadlocker 272 | 98618-03 | 10 ml bottle |
| Special Purpose Grease | 99857-97 | 14 oz. cartridge |
| Super Oil | 94968-85TV | 1/4 fl. oz |
| Type "E" Hydraulic Fork Oil | 99884-80 | 16 oz bottle |

## FUEL

Refer to Table 1-4. Always use a good quality unleaded gasoline. Octane ratings are usually found on the pump.

**⚠WARNING**

**Avoid spills. Slowly remove filler cap. Do not fill above bottom of filler neck insert, leaving air space for fuel expansion. Secure filler cap after refueling. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00028a)**

**⚠WARNING**

**Use care when refueling. Pressurized air in fuel tank can force gasoline to escape through filler tube. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00029a)**

Modern service station pumps dispense a high flow of gasoline into a motorcycle fuel tank making air entrapment and pressurization a possibility.

**Table 1-4. Octane Ratings**

| SPECIFICATION | RATING |
|---|---|
| Pump Octane (R+M)/2 | 91 (95 RON) |

## GASOLINE BLENDS

Your motorcycle was designed to get the best performance and efficiency using unleaded gasoline. Most gasoline is blended with alcohol and/or ether to create oxygenated blends. The type and amount of alcohol or ether added to the fuel is important.

**CAUTION**

**Do not use gasoline that contains methanol. Doing so can result in fuel system component failure, engine damage and/or equipment malfunction. (00148a)**

- Gasoline containing METHYL TERTIARY BUTYL ETHER (MTBE): Gasoline/MTBE blends are a mixture of gasoline and as much as 15% MTBE. Gasoline/MTBE blends can be used in your motorcycle.
- ETHANOL is a mixture of 10% ethanol (Grain alcohol) and 90% unleaded gasoline. Gasoline/ethanol blends can be used in your motorcycle if the ethanol content does **not** exceed 10%.
- REFORMULATED OR OXYGENATED GASOLINES (RFG): Reformulated gasoline is a term used to describe gasoline blends that are specifically designed to burn cleaner than other types of gasoline, leaving fewer tailpipe emissions. They are also formulated to evaporate less when you are filling your tank. Reformulated gasolines use additives to oxygenate the gas. Your motorcycle will run normally using this type of gas and Harley-Davidson recommends you use it when possible, as an aid to cleaner air in our environment.
- Do not use race gas or octane boosters. Use of these fuels will damage the fuel system.

Some gasoline blends might adversely affect the starting, driveability or fuel efficiency of the motorcycle. If any of these problems are experienced, try a different brand of gasoline or gasoline with a higher octane blend.

## ENGINE LUBRICATION

**CAUTION**

**Do not switch lubricant brands indiscriminately because some lubricants interact chemically when mixed. Use of inferior lubricants can damage the engine. (00184a)**

Engine oil is a major factor in the performance and service life of the engine. Always use the proper grade of oil for the lowest temperature expected before the next scheduled oil change. Refer to Table 1-5. Your authorized dealer has the proper oil to suit your requirements.

If it is necessary to add oil and Harley-Davidson oil is not available, use an oil certified for diesel engines. Acceptable diesel engine oil designations include: CF-4, CG-4, CH-4 and CI-4.

The preferred viscosities for the diesel engine oils in descending order are: 20W50, 15W40 and 10W40.

At the first opportunity, see an authorized dealer to change back to 100 percent Harley-Davidson oil.

**Table 1-5. Recommended Engine Oils: VRSC Models**

| HARLEY-DAVIDSON TYPE | VISCOSITY | HARLEY-DAVIDSON RATING | LOWEST AMBIENT TEMPERATURE | COLD WEATHER STARTS BELOW 50° F (10° C) |
|---|---|---|---|---|
| HD Multi-grade | SAE 10W40 | HD 360 | Below 40° F (4° C) | Excellent |
| HD Multi-grade | SAE 20W50 | HD 360 | Above 40° F (4° C) | Good |

## WINTER LUBRICATION

In colder climates, the engine oil should be changed often. If motorcycle is used frequently for short trips, less than 24 kilometers (15 miles), in ambient temperatures below 16° C (60° F), oil change intervals should be reduced to 2400 kilometers (1500 miles). Motorcycles used only for short runs

must have a thorough tank flush-out before **new** oil is put in. The tank flush-out should be performed by an authorized dealer or qualified technician.

*NOTE*

*The further below freezing the temperature drops, the shorter the oil change interval should be.*

Water vapor is a normal by-product of combustion in any engine. During cold weather operation, some of the water vapor condenses to liquid form on the cool metal surfaces inside the engine. In freezing weather this water will become slush or ice and, if allowed to accumulate too long, may block the oil lines and cause damage to the engine.

If the engine is run frequently and allowed to thoroughly warm up, most of this water will become vapor again and will be blown out through the crankcase breather.

If the engine is not run frequently and allowed to thoroughly warm up, this water will accumulate, mix with the engine oil and form a sludge that is harmful to the engine.

# BULB REQUIREMENTS 1.4

## GENERAL

Refer to Table 1-6. This table gives the location and bulb requirements for Harley-Davidson VRSC motorcycles.

*NOTES*

- *All VRSC speedometers, tachometers indicator lamps and odometers are illuminated with LEDs.*
- *LEDs are non-repairable. The entire instrument cluster must be replaced if an LED fails.*

**Table 1-6. Bulb Chart: 2008 VRSC Models**

| LAMP | DESCRIPTION (ALL LAMPS 12 VOLT) | BULBS REQUIRED | CURRENT DRAW (AMPERAGE) | H-D PART NUMBER |
|---|---|---|---|---|
| Headlamp VRSCAW | low beam | 1 | 4.30 | 68881-01 |
| | high beam | 1 | 5.10 | 67717-01 |
| Headlamp VRSCD, VRSCDX | low beam/high beam | 1 | 4.58/5.00 | 68329-03 |
| Position lamp international | position lamp | 1 | 0.36 | 53436-97 |
| Tail and stop lamp | tail lamp | 1 | 0.59 | 68168-89A |
| | stop lamp | 1 | 2.25 | 68168-89A |
| | license plate illumination | 2 | 0.33 | 68193-95 |
| | tail lamp international | 1 | 0.42 | 68169-90A |
| | stop lamp international | 1 | 1.75 | 68169-90A |
| | license plate illumination international | 2 | 0.37 | 53436-97 |
| Turn signal lamp | front/running | 2 | 2.25/0.59 | 68168-89 |
| | rear | 2 | 2.25 | 68572-64B |
| | front/running international | 2 | 1.75 | 68163-84 |
| | rear international | 2 | 1.75 | 68163-84 |
| Instrument cluster | Illuminated with LEDs. Replace entire assembly upon failure. | | | |

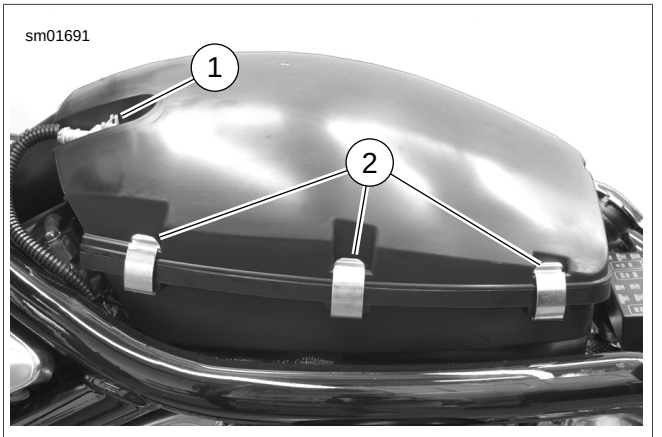
## REMOVAL

1. Open seat.
2. See Figure 1-1. Remove airbox cover by turning bailhead fastener 1/4 turn counterclockwise (CCW). Pull airbox cover away from locating holes.




**Figure 1-1. Airbox Cover Bailhead Fastener (typical)**

3. See Figure 1-2. Remove IAT connector (1) by pushing down on bail wire to unlock. Airbox top is retained by eight clips (2), three per side, one at the rear and one in the front under the snorkel. Disconnect clips and remove airbox top.




1. **IAT connector [89]**
2. **Retaining clips**

**Figure 1-2. Air Filter Top**

4. See Figure 1-3. Remove wing nut securing filter cap and air filter.

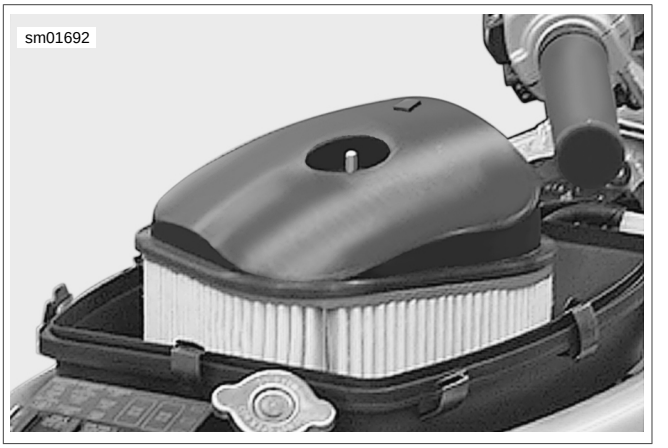
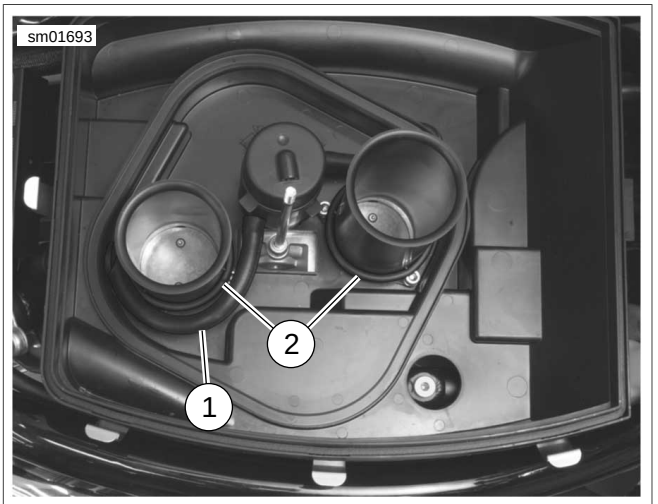



**Figure 1-3. Air Filter**

5. See Figure 1-4. Disconnect breather hose (1). Slide velocity stack o-ring (2) up the velocity stack body to access the three retaining fasteners. Remove the velocity stacks.




1. **Breather hose**
2. **O-rings**

**Figure 1-4. Velocity Stacks (typical)**

6. Gently lift the air filter bottom. Front breather hose is a press-fit and will disconnect, rear breather has a worm clamp holding hose to air filter bottom. Loosen clamp and remove air filter bottom.

**CAUTION**

**Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)**

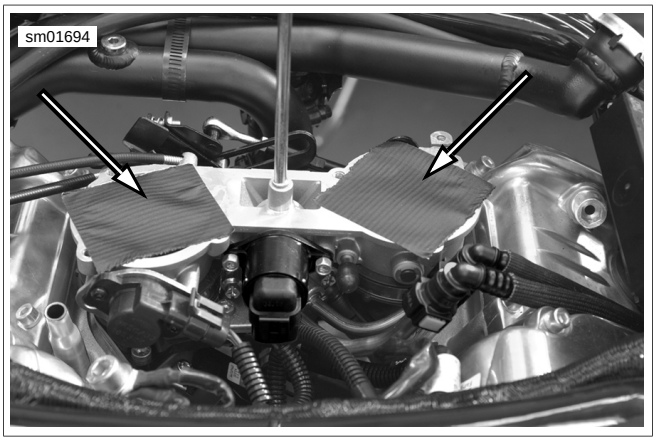



**Figure 1-5. Airbox Removed (Injector intakes shown by arrows)**

## INSTALLATION

1. Remove tape from throttle body intakes.
2. See Figure 1-6. Inspect and replace bottom airbox gasket if damaged. Check gasket position on air filter bottom. Gasket is located by three alignment pins on mating surface.

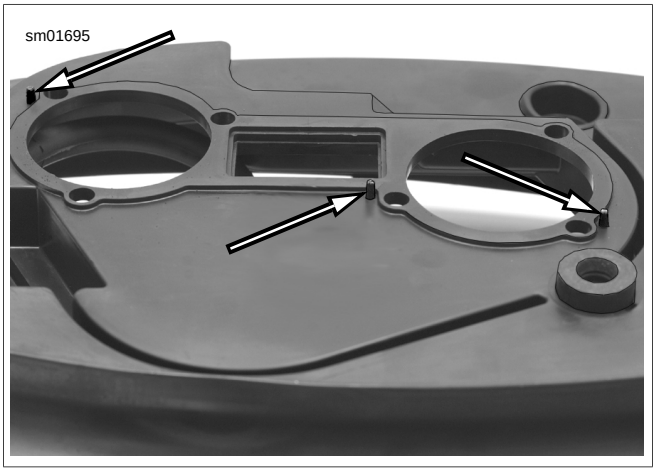



**Figure 1-6. Air Filter Gasket Alignment Pins (3)**

3. Place air filter bottom over throttle body and attach rear breather hose with hose clamp.
4. Align air filter bottom with front breather hose and press firmly in position.

*NOTE*

*Velocity stacks have a mark at the bottom flange between two of the fastener locations. Align the mark with the corresponding mark on the air filter bottom.*




**Figure 1-7. Velocity Stack Alignment Marks**

5. Align index marks and install velocity stacks, longest in front. Tighten fasteners to 6 Nm (53 **in-lbs**).
6. Slide o-rings down the velocity stack body until they contact the three fasteners.

*NOTE*

*The o-rings retain the velocity stack fasteners when assembling airbox.*

7. Attach the breather hose.
8. Place air filter element in air filter bottom.
9. Align air filter cap and fasten with wing nut. Turn wing nut 2.5-3 turns after contact.
10. Position air filter top over bottom section with snorkel between frame tubes at the steering neck.
11. Fasten clips along each side and clip at rear.

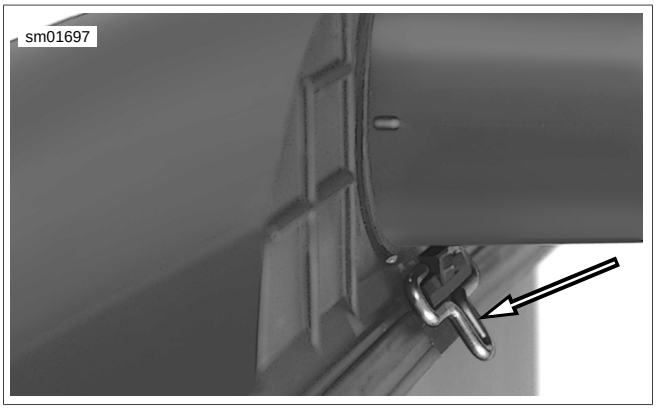
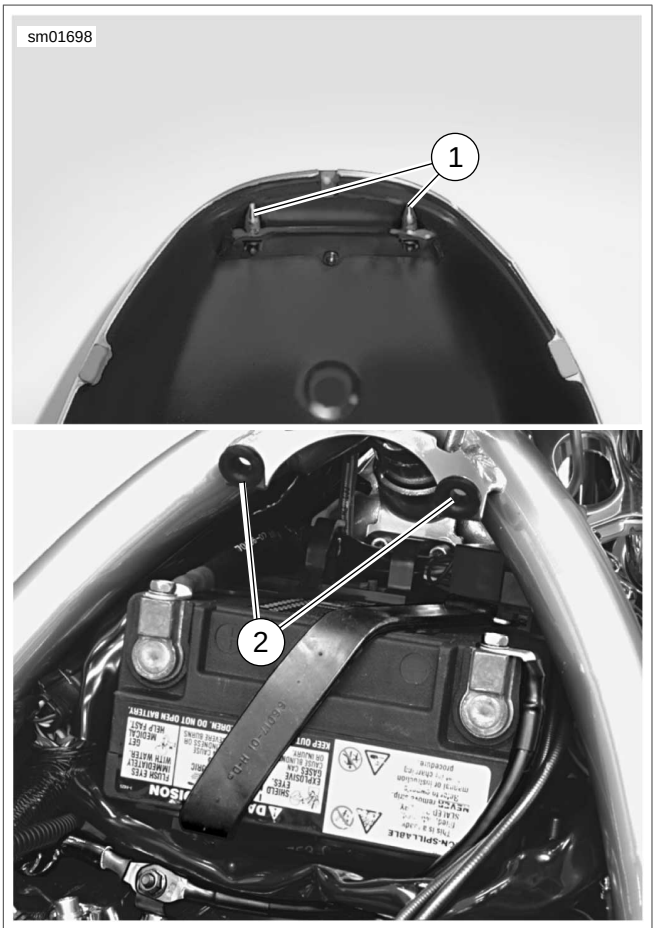



**Figure 1-8. Front Airbox Clip**

12. See Figure 1-8. Front clip under snorkel is attached to top section and must be fastened over the lip on the air filter bottom.
13. See Figure 1-2. Attach IAT connector.
14. See Figure 1-9. Position the airbox cover with the locating pins (1) in the holes (2) on the frame tabs.
15. See Figure 1-1. Turn bailhead fastener 1/4 turn clockwise.




**1. Locating pins**
**2. Frame tab holes**

**Figure 1-9. Airbox Cover and Frame Tabs (typical)**

## EXHAUST SYSTEM LEAK CHECK

Check the exhaust system for leaks at every scheduled service interval as follows:

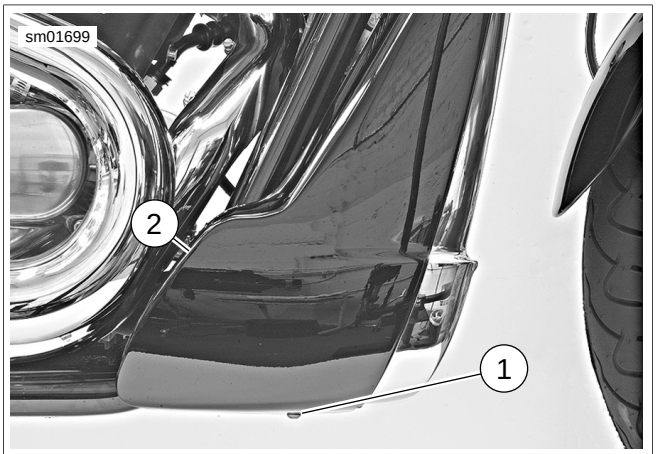
1. Check entire exhaust system for loose or missing fasteners, broken pipe clamps or brackets, and obvious signs of leakage (carbon tracks at pipe joints, etc.).
2. Check for loose or broken heat shields. Repair or replace as necessary.
3. Start engine, cover muffler ends with clean, dry shop towels and listen for audible signs of exhaust leakage.
4. Correct any leaks detected. See 4.14 EXHAUST SYSTEM: VRSCAW, 4.15 EXHAUST SYSTEM: VRSCD or 4.16 EXHAUST SYSTEM: VRSCDX for exhaust system removal and installation procedures.

## REMOVAL

*NOTE*

*The radiator side covers are delicate and should not be forced into or from mounted position. Use care during removal and installation to avoid damage.*

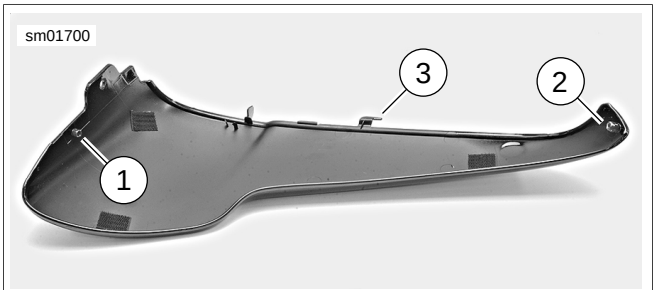
1. Remove maxi-fuse.




1. **Lower radiator side cover fastener**
2. **Radiator side cover**

**Figure 1-10. Lower Radiator Side Cover Fastener (typical) (mid mount control right side shown)**

2. See Figure 1-10. Remove lower radiator side cover fastener.




1. **Bottom mounting pin**
2. **Top mounting pin**
3. **Latching tab**

**Figure 1-11. Radiator Side Cover (typical) (inside view)**

3. See Figure 1-11. Radiator side cover is held in place by a bottom mounting pin (1), top mounting pin (2) and latching tab (3). Remove radiator side covers as follows:
   a. See Figure 1-12. Grasp bottom of radiator side cover and pull down gently to disengage bottom mounting pin from bottom mounting hole located in radiator front cover.
   b. See Figure 1-13. While supporting radiator side cover, grasp top of side cover and pull up gently to disengage top mounting pin from mounting hole in front cover.
   c. Slide radiator side cover down gently to disengage latching tab from mounting lip in radiator front cover.
   d. Set radiator side cover aside.

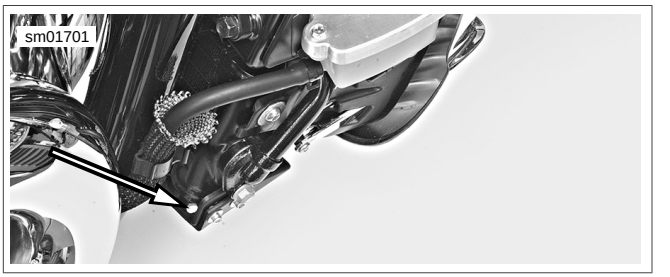



**Figure 1-12. Bottom Mounting Hole**

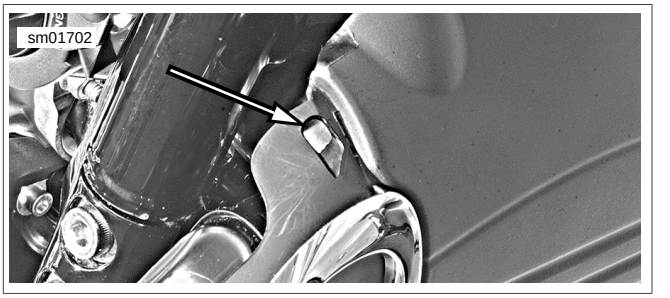



**Figure 1-13. Top Mounting Hole**




**Figure 1-14. Tab Mounting Lip**

## INSTALLATION

1. See Figure 1-11. Position radiator side cover on radiator front cover and gently slide side cover upward until latching tab fits into tab mounting lip.
2. See Figure 1-13. Engage top mounting pin of radiator side cover into top mounting hole of radiator front cover.
3. See Figure 1-12. Engage lower mounting pin of radiator side cover into bottom mounting hold of radiator front cover.
4. See Figure 1-10. Install radiator side cover fastener and tighten to 3-4 Nm (27-35 **in-lbs**).

## CHECKING COOLANT LEVEL IN OVERFLOW BOTTLE

1. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**⚠ WARNING**

**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

**CAUTION**

**Use only Genuine Harley-Davidson Extended Life Anti-freeze and Coolant. Use of other coolants/mixtures may lead to engine damage. (00179b)**

2. See Figure 1-15. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line on tank, remove cap from tank by using pull tab and add Harley-Davidson, FULLY FORMULATED ANTIFREEZE until fluid level reaches COLD FULL line.

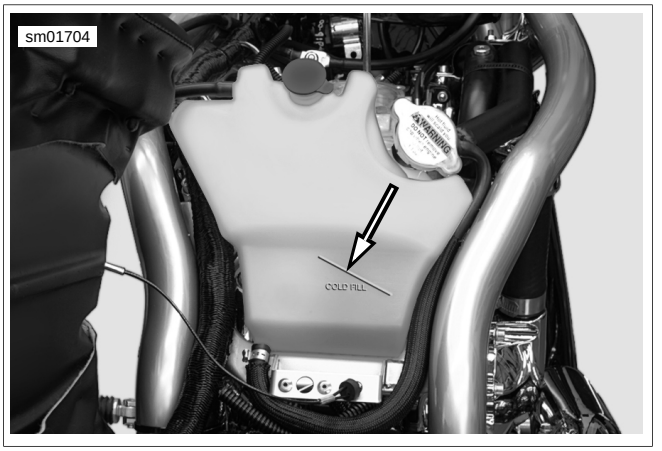



**Figure 1-15. Cold Full Line On Overflow Bottle**

## CHECK FOR COOLANT IN SYSTEM

Coolant may be visible in the overflow bottle but not present in the rest of the cooling system. To ensure coolant is present:

1. Remove air filter top. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

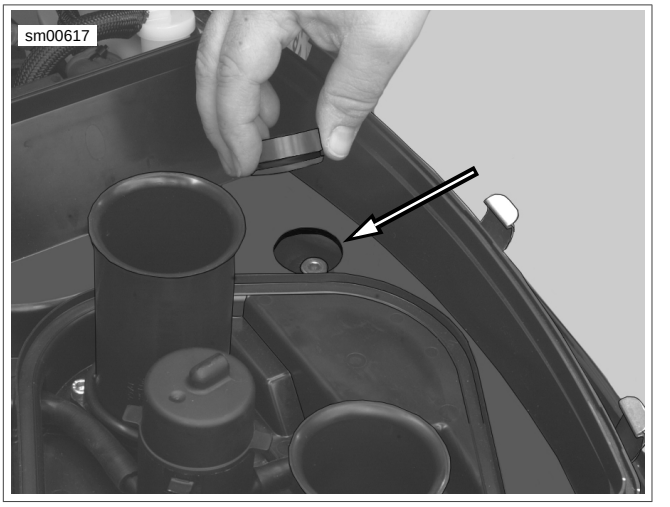



**Figure 1-16. Air Bleed Plug @ 9-11 Nm (80-97 in-lbs)**

2. See Figure 1-16. Remove cooling system air bleed plug.
3. Gently squeeze vertical water pump coolant hose on right side of engine.
4. Coolant should be visible in the air bleed hole. If coolant is not visible, see 6.3 ENGINE COOLANT.

## CHECKING AND ADDING OIL

**CAUTION**

**Oil level cannot be accurately measured on a cold engine. For pre-ride inspection with the motorcycle upright (not leaning on jiffy stand) on level ground, the oil should register approximately at the midpoint of the cross-hatch area on the dipstick when the engine is cold. Do not add oil to bring the level to the full mark on a cold engine. (00186b)**

*NOTE*

*This engine has a wet sump, an integral transmission, gear driven primary drive and wet clutch. This design allows engine oil in the sump to be used to lubricate the engine, transmission and primary drive. The clutch and primary drive are located on the right side of the engine.*

### Cold Engine Oil Level Check

Check engine oil level with engine **COLD** as follows:

1. Stand motorcycle upright (not leaning on jiffy stand) on a level surface.
2. See Figure 1-17. Unscrew the oil filler cap (with attached dipstick) by turning the filler cap counterclockwise. Remove the filler cap and dipstick and wipe the dipstick clean.
3. Screw the filler cap into the engine. Make sure the cap is fully seated on the crankcase.
4. See Figure 1-18. Remove the filler cap again and check the oil level on the dipstick.
5. See Figure 1-18. If the oil level is below the midpoint of the cross-hatch area on the dipstick, add enough Harley-Davidson oil to bring the level up to the midpoint of the cross-hatch area shown.

**CAUTION**

**Do not operate the engine when the oil level is below the add mark on the dipstick at operating temperature. Engine damage will result. (00187b)**

### Hot Engine Oil Level Check

Check engine oil level with **engine at normal operating temperature as follows:**

1. Stop engine and allow oil to drain into sump for **about three minutes.**
2. Stand motorcycle upright (not leaning on jiffy stand) on a level surface.
3. See Figure 1-17. Unscrew filler cap (with attached dipstick) located at front of engine on left side. Remove filler cap and dipstick and wipe dipstick clean.
4. Screw filler cap into engine. Make sure cap is fully seated on crankcase.

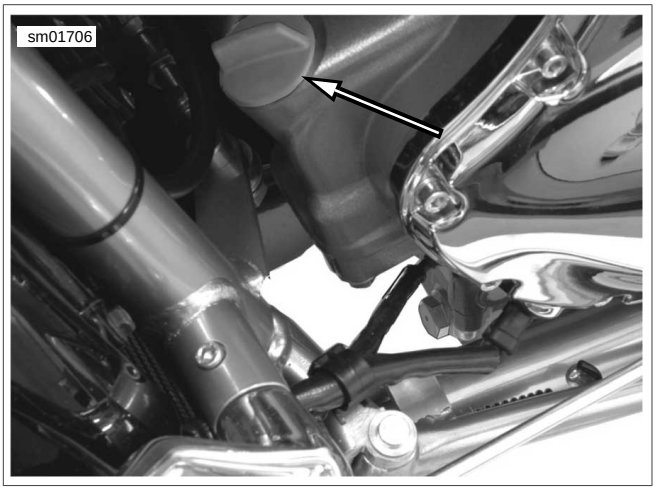



**Figure 1-17. Dipstick/Filler Cap**

5. See Figure 1-17. Remove filler cap and check oil level on dipstick.

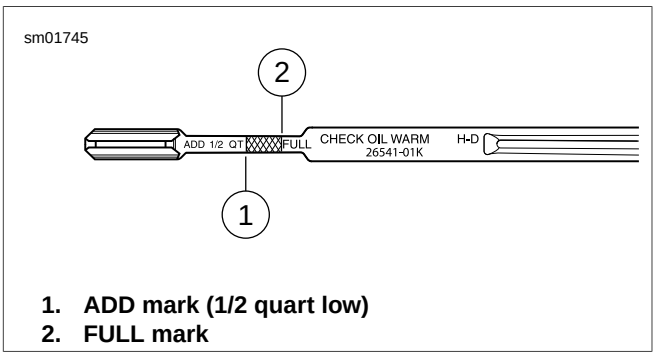
**CAUTION**

**To avoid over-filling the oil sump, wait approximately three minutes after adding oil before checking the oil level with the dipstick. An over-filled sump can cause engine damage. (00188a)**

6. If oil level is below FULL mark on the cross-hatched band of the dipstick, add enough Harley-Davidson oil to bring level up to the FULL mark. Observe CAUTION stated below.

**CAUTION**

**Do not allow hot oil level to fall below Add/Fill mark on dipstick. Doing so can result in equipment damage and/or equipment malfunction. (00189a)**




1. **ADD mark (1/2 quart low)**
2. **FULL mark**

**Figure 1-18. Dipstick**

*NOTE*

*Cross hatched band of dipstick indicates 0.47 liter (1/2 quart) of Harley-Davidson oil.*

## CHANGING OIL AND FILTER

**CAUTION**

**Use Harley-Davidson oil filter wrench for filter removal. This tool can prevent damage to crankshaft position sensor and/or sensor cable. (00192b)**

Change engine oil and filter:

- At the first scheduled service interval.
- At every 8000 km (5000 mile) and 6437 km (4000 mile) for) VRSCX only) service interval thereafter.
- When storing or removing the motorcycle for the season.

*NOTE*

*If the motorcycle is ridden hard, under dusty conditions, or in cold weather, the oil and filter should be changed more often.*

*VRSC models are shipped from the factory with Harley-Davidson Motor Oil.*

*VRSC models come equipped from the factory with a premium 10 micron synthetic media oil filter. These are the only recommended replacement filters.*

1. Ride motorcycle until engine is warmed up to normal operating temperature.
2. See Figure 1-17. Remove the oil filler plug/dipstick on left side.
3. See Figure 1-19. Remove the engine oil drain plug at front of oil pan on left side. Allow oil to drain into a suitable container.

*NOTE*

*Lower radiator mounting bracket can be loosened and moved forward slightly to improve access to oil filter.*

4. Remove the oil filter using the OIL FILTER WRENCH. Clean the oil filter mount flange of any old gasket material.
5. See Figure 1-21. Lube the gasket on **new** oil filter with engine oil and install **new** filter. Hand tighten oil filter 2/3 to 1 turn after gasket contacts filter mounting surface.
6. See Figure 1-19. Install oil drain plug.
   a. Inspect oil drain plug for damage. Replace if required. Wipe any foreign material from plug.
   b. Install drain plug. Tighten to 35 Nm (25.8 ft-lbs).
7. See Figure 1-17. Select the grade of oil for the lowest temperature expected before next oil change. Refer to Table 1-4.

*NOTE*

*The position of the motorcycle when draining oil affects the amount of residual oil in the crankcase. Do not overfill.*

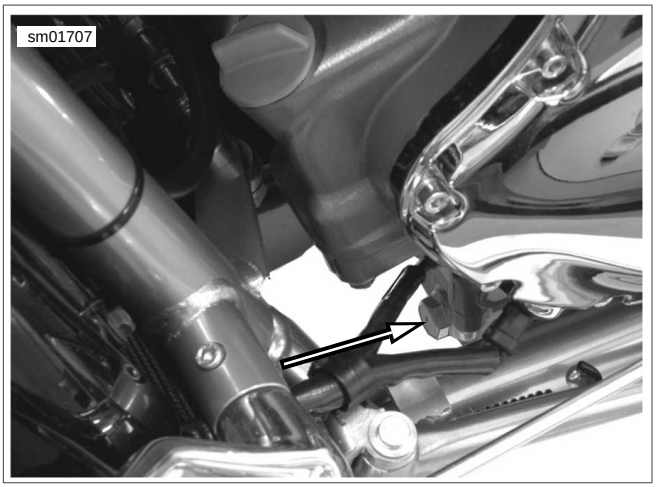



**Figure 1-19. Oil Drain Plug (typical)**

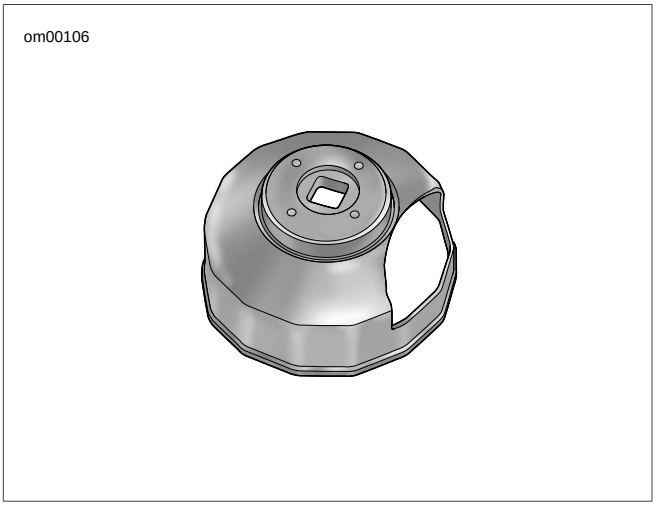



**Figure 1-20. Oil Filter Wrench (Part No. HD-44067)**

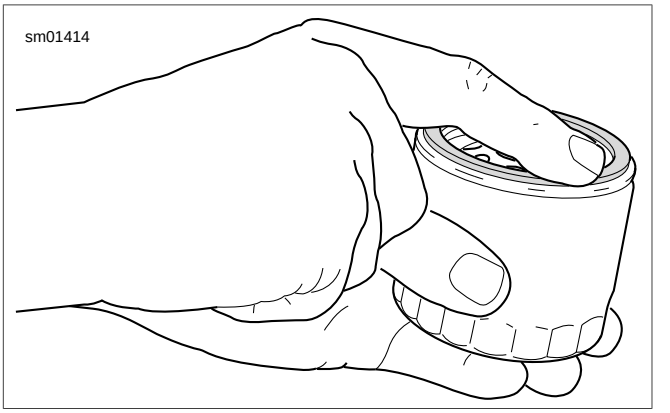



**Figure 1-21. Lubricating New Oil Filter Gasket**

8. Fill engine and perform a cold engine oil level check until oil level indicates a level on the cross-hatched band of the dipstick. See Cold Engine Oil Level Check under 1.8 ENGINE OIL AND FILTER.

*NOTE*

*Maximum capacity of oil system is 4.7 liters (5 quarts).*

9. Start engine and carefully check for oil leaks around drain plug and oil filter.
10. Perform a complete hot engine oil level check. See Hot Engine Oil Level Check in 1.8 ENGINE OIL AND FILTER.

**Table 1-7. Recommended Engine Oils: VRSC Models**

| HARLEY-DAVIDSON TYPE | VISCOSITY | HARLEY-DAVIDSON RATING | LOWEST AMBIENT TEMPERATURE | COLD WEATHER STARTS BELOW 50° F (10° C) |
|---|---|---|---|---|
| HD Multi-grade | SAE 10W40 | HD 360 | Below 40° F (4° C) | Excellent |
| HD Multi-grade | SAE 20W50 | HD 360 | Above 40° F (4° C) | Good |

## GENERAL

**⚠WARNING**

**Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. KEEP BATTERIES AWAY FROM CHILDREN. (00063a)**

**⚠WARNING**

**Never remove warning label attached to top of battery. Failure to read and understand all precautions contained in warning, could result in death or serious injury. (00064a)**

**⚠WARNING**

**Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer, and birth defects or other reproductive harm. Wash hands after handling. (00019e)**

All AGM batteries are permanently sealed, maintenance-free, valve-regulated, lead/calcium and sulfuric acid batteries. The batteries are shipped pre-charged and ready to be put into service. Do not attempt to open these batteries for any reason.

*NOTE*

*For charging information, see 1.9 BATTERY MAINTENANCE, Charging Battery. For testing information, see ELECTRICAL DIAGNOSTIC MANUAL.*

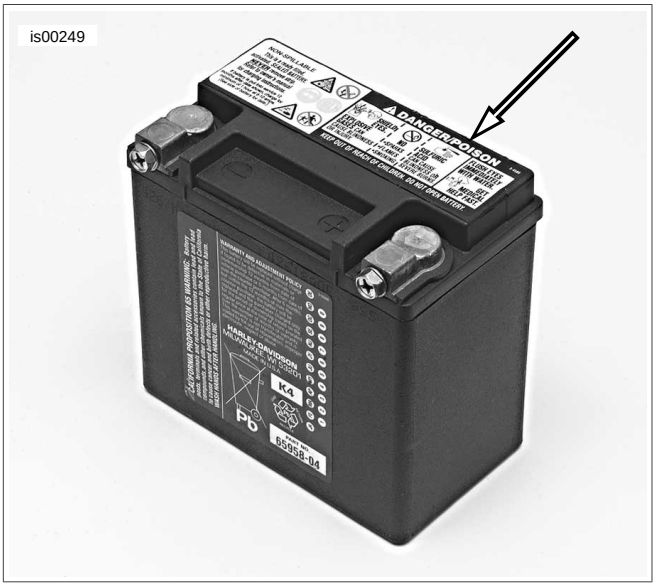
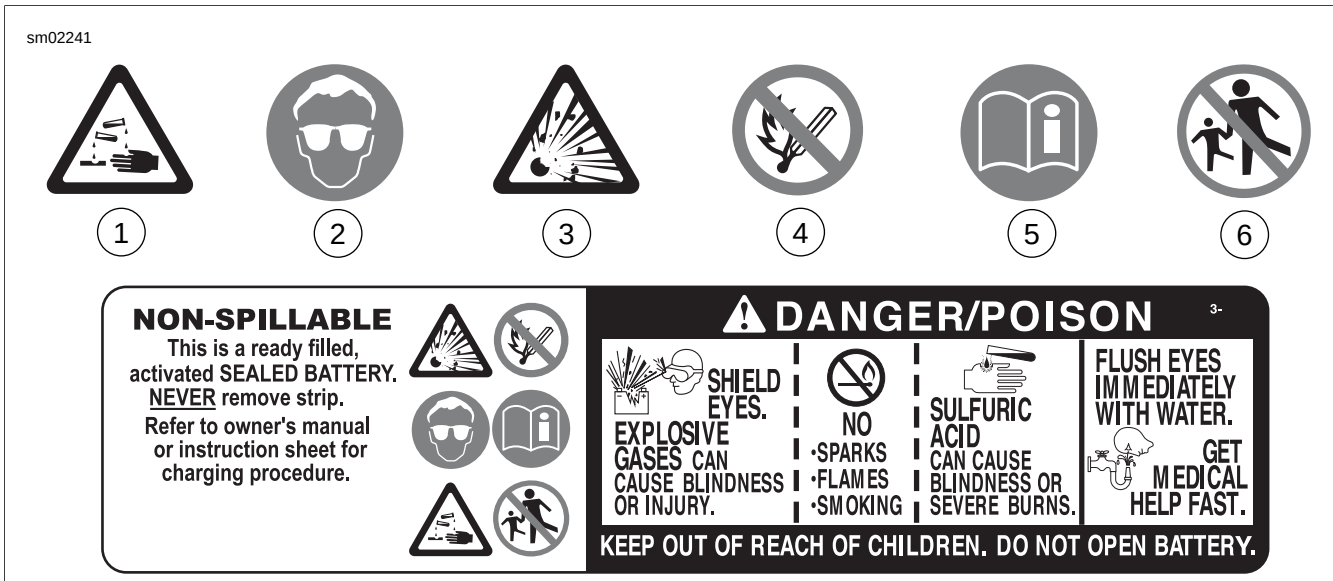



**Figure 1-22. AGM Battery with Warning Label**




1. Contents are corrosive
2. Wear safety glasses
3. Contents are explosive
4. Keep flames away
5. Read instructions
6. Keep away from children

**Figure 1-23. Battery Warning label**

**Table 1-8. Antidotes for Battery Acid**

| CONTACT | TREATMENT |
|---|---|
| External | Flush with water. |
| Internal | Drink large quantities of milk or water, followed by milk of magnesia, vegetable oil or beaten eggs. Get immediate medical attention. |
| Eyes | Flush with water. Get immediate medical attention. |

## DISCONNECTION/REMOVAL

1. Remove airbox cover, right side cover, and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove complete airbox and airbox stud. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**CAUTION**

**Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)**

3. See Figure 1-24. Cover injector intakes (injector bore).

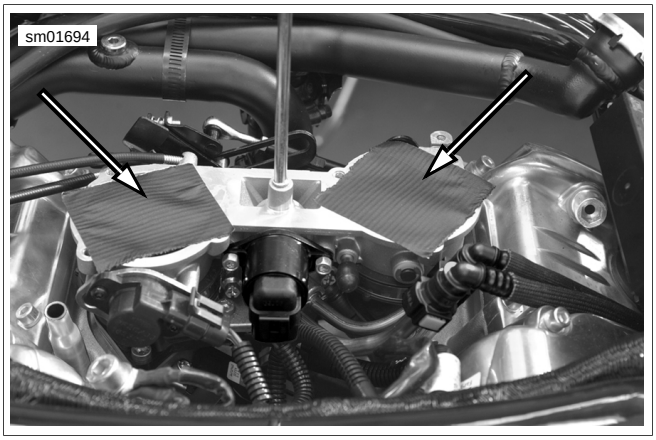
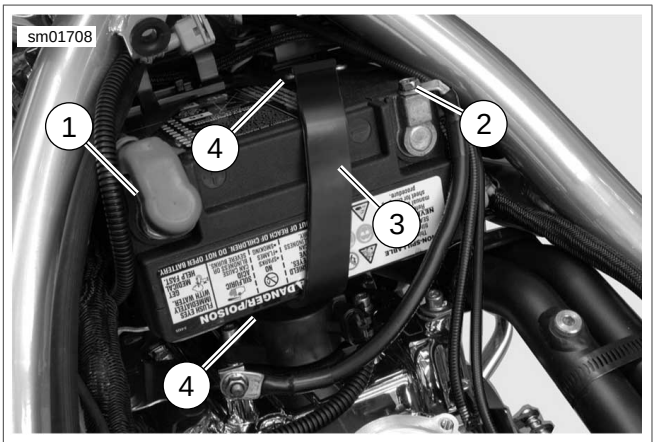



**Figure 1-24. Airbox Removed (Injector intakes shown by arrows)**

**WARNING**

**Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)**

4. See Figure 1-26. Remove negative battery terminal bolt, and positive battery terminal bolt.
5. Stretch battery hold down strap and remove from tab to release tension on strap. Battery hold down strap will then come free from lower tab and can be completely removed.
6. Firmly pull battery out and slightly upward to remove battery from battery caddy.
7. Refer to Table 8-7. Check battery voltage and make sure it is at recommended specification. Charge battery at rate and time specified as required.




1. **Positive battery terminal hold down bolt (located under boot)**
2. **Negative battery terminal bolt**
3. **Hold down strap**
4. **Tabs**

**Figure 1-25. Battery Removal (typical)**

## CLEANING AND INSPECTION

1. Battery top must be clean and dry. Dirt and electrolyte on top of the battery can cause battery to self-discharge. Clean battery top with a solution of baking soda (sodium bicarbonate) and water (5 teaspoons baking soda per quart or liter of water). When the solution stops bubbling, rinse off the battery with clean water.
2. Clean cable connectors and battery terminals using a wire brush or sandpaper. Remove any oxidation.
3. Inspect the battery screws, clamps and cables for breakage, loose connections and corrosion. Clean clamps.
4. Check the battery posts for melting or damage caused by overtightening.
5. Inspect the battery for discoloration, raised top or a warped or distorted case, which might indicate that the battery has been frozen, overheated or overcharged.
6. Inspect the battery case for cracks or leaks.

## CHARGING BATTERY

### Safety Precautions

Never charge a battery without first reviewing the instructions for the charger being used. In addition to the manufacturer's instructions, follow these general safety precautions:

- Always wear eye, face and hand protection.
- Always charge batteries in a well-ventilated area.
- Turn the charger off before connecting the leads to the battery to avoid dangerous sparks.
- Never try to charge a visibly damaged or frozen battery.
- Connect the charger leads to the battery; red positive (+) lead to the positive (+) terminal and black negative (-) lead to the negative (-) terminal. If the battery is still in the vehicle, connect the negative lead to the chassis ground.

Be sure that the ignition and all electrical accessories are turned off.

- Make sure that the charger leads to the battery are not broken, frayed or loose.
- If the battery gets hotter than 43° C (110° F) during charging, discontinue charger and allow the battery to cool.
- Always turn the charger off before removing charger leads from the battery to avoid dangerous sparks.

## Using a Battery Charger

Charge the battery if any of the following conditions exist:

- Vehicle lights appear dim.
- Electric starter sounds weak.
- Battery has not been used for an extended period of time.

**⚠WARNING**

**Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. KEEP BATTERIES AWAY FROM CHILDREN. (00065a)**

**CAUTION**

**If battery releases an excessive amount of gas during charging, decrease the charging rate. Overheating can result in plate distortion, internal shorting, drying out or damage. (00413b)**

1. Perform a voltmeter test to determine the state of charge. See the ELECTRICAL DIAGNOSTIC MANUAL. If battery needs to be charged, proceed to the next step.

*NOTE*

*The figures listed in the table assume that the battery is charging at room temperature. If warmer than room temperature, use a slightly shorter charging time. If colder, use a slightly longer charging time.*

**Table 1-9. Battery Charging Rates/Times (Approximate)**

| BATTERY AMP HOUR | STATE OF CHARGER | | 3 AMP CHARGER | 6 AMP CHARGER | 10 AMP CHARGER | 20 AMP CHARGER |
|---|---|---|---|---|---|---|
| | VOLTAGE | % OF CHARGE | | | | |
| 12 | 12.7 | 100% | N/A | N/A | N/A | N/A |
| | 12.6 | 75% | 1 hour 50 minutes | 55 minutes | 30 minutes | 15 minutes |
| | 12.3 | 50% | 3 hours 20 minutes | 1 hour 50 minutes | 1 hour 5 minutes | 30 minutes |
| | 12.0 | 25% | 5 hours 15 minutes | 2 hours 40 minutes | 1 hour 55 minutes | 45 minutes |
| | 11.8 | 0% | 7 hours | 3 hours 30 minutes | 2 hours 5 minutes | 1 hour 5 minutes |

*NOTE*

*The use of constant current chargers to charge sealed maintenance-free batteries is not recommended. Any overcharge will cause dry-out and premature battery failure. If a constant current charger is the only type available, do **not** exceed the charge times listed above and do **not** continue charging the battery if it gets hot. When charging, never exceed 15 volts for more than 30 minutes.*

**⚠WARNING**

**Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a)**

**CAUTION**

**Do not reverse the charger connections described in the following steps or the charging system of the motorcycle could be damaged. (00214a)**

2. Connect red battery charger lead to the positive (+) terminal of the battery.
3. Connect black battery charger lead to the negative (-) terminal of the battery.

*NOTE*

*If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.*

4. Step away from the battery and turn on the charger. See the charging instructions in Table 1-9.

**⚠WARNING**

**Unplug or turn OFF battery charger before disconnecting charger cables from battery. Disconnecting clamps with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00067a)**

5. After the battery is fully charged, disconnect the black battery charger lead to the negative (-) terminal of the battery.
6. Disconnect the red battery charger lead to the positive (+) terminal of the battery.
7. Mark the charging date on the battery.
8. Perform either a conductance test or load test to determine the condition of the battery. See the ELECTRICAL DIAGNOSTIC MANUAL.
9. If charging battery because voltmeter test reading was below 12.6 V, perform voltmeter test. See the ELECTRICAL DIAGNOSTIC MANUAL.

## INSTALLATION/CONNECTION

**CAUTION**

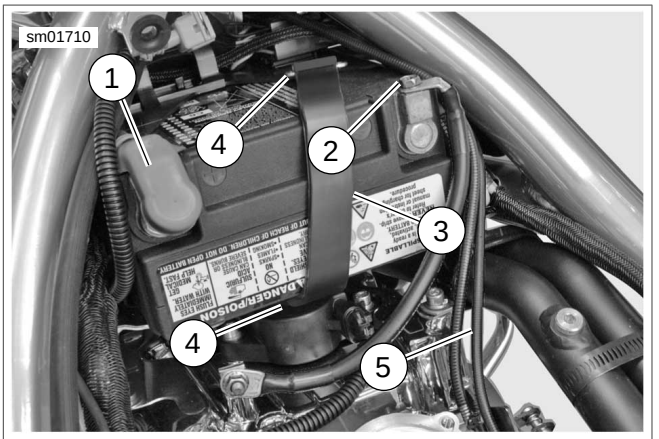
**Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)**

**CAUTION**

**Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)**

**⚠WARNING**

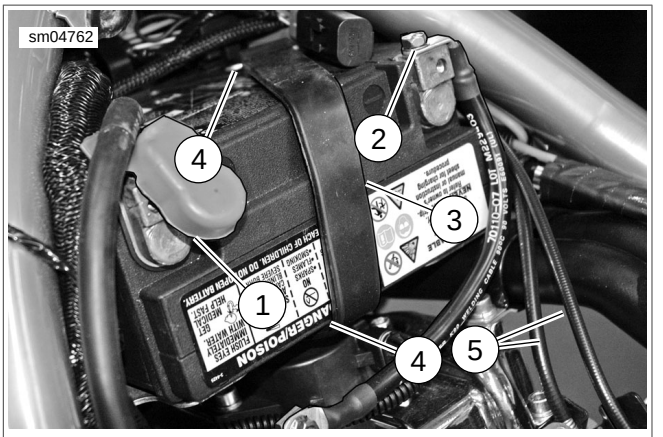
**Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)**




1. **Hold-down strap**
2. **Tab**
3. **Positive battery terminal bolt (located under boot)**
4. **Negative battery terminal bolt**
5. **Throttle cables**

**Figure 1-26. Battery Installed**

1. See Figure 1-26. Insert battery into tray into battery caddy.
2. Connect hold down strap to bottom of battery caddy.
3. Install battery with terminals facing upward.




1. **Positive battery teminal hold down bolt (located under boot)**
2. **Negative battery terminal bolt**
3. **Hold down strap**
4. **Tabs (strap anchor points, one located under battery tray)**
5. **Throttle cables**

**Figure 1-27. Battery Installed**

4. Verify proper routing of throttle cables.
5. Stretch hold down strap over top of battery. Latch hold down strap to tab on top of battery caddy.
6. Connect positive battery cable first. Tighten terminal bolt to 6-10 Nm (53-89 **in-lbs**) and cover terminal with protective terminal boot.
7. Connect negative battery cable and tighten terminal bolt to 6-10 Nm (53-89 **in-lbs**).

*NOTE*

*Battery must sit flat on bottom of tray pad. Verify that battery does not sit on front edge of tray pad.*

8. Remove covering over throttle bodies.
9. Install airbox. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
10. Install maxi-fuse and side cover.
11. Close seat.

## STORAGE

| PART NUMBER | TOOL NAME |
|---|---|
| 99863-01A | GLOBAL BATTERY CHARGER |

**⚠WARNING**

**Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. KEEP BATTERIES AWAY FROM CHILDREN. (00063a)**

**CAUTION**

**Do not allow battery to completely discharge. The electrolyte in a discharged battery will freeze. The more discharged a battery is, the more easily it can freeze and crack the battery case. (00218a)**

If the motorcycle is to be stored with the security system armed, connect a GLOBAL BATTERY CHARGER (Part No. 99863-01A) to maintain battery charge.

If the motorcycle is to be stored with the battery installed, a GLOBAL BATTERY CHARGER unavailable, and with the security system **not** armed, unplug the maxi-fuse.

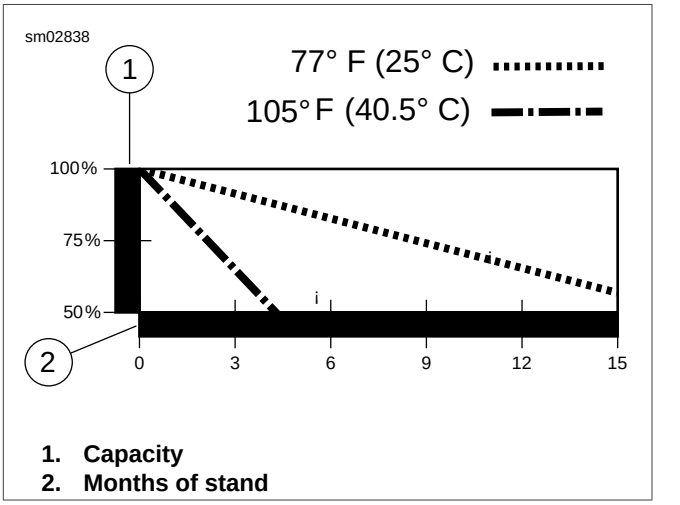
If the motorcycle will not be operated for several months, such as during the winter season, remove the battery from the motorcycle and fully charge.

See Figure 1-28. Self-discharge is a normal condition and occurs continuously at a rate that depends on the ambient temperature and the battery's state of charge. Batteries discharge at a faster rate at higher ambient temperatures. To reduce the self-discharge rate, store battery in a cool (not freezing), dry place.

Charge the battery every month if stored at temperatures below 16° C (60° F). Charge the battery more frequently if stored in a warm area above 16° C (60° F).

*NOTES*

- *The GLOBAL BATTERY CHARGER (Part No. 99863-01A) may be used to maintain battery charge for extended periods of time without risk of overcharging or boiling.*
- *When returning a battery to service after storage, see ELECTRICAL DIAGNOSTIC MANUAL.*




**1. Capacity**
**2. Months of stand**

**Figure 1-28. Battery Self-Discharge Rate**

## FLUID INSPECTION

**CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

**CAUTION**

**Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)**

1. See Figure 1-29. Check level in rear brake master cylinder reservoir. Level should be 12.7 mm (0.5 in.) below the gasket surface.
   a. Remove cooling system side cover fastener on underside of side cover.
   b. Swing out lower section and lift to unhook from top of assembly.
   c. View fluid level through sight window at rear of reservoir.

*NOTE*

*To prevent dirt from entering the master cylinder reservoir, thoroughly clean the cover before removal.*

2. See Figure 1-31. Check level in front brake master cylinder reservoir. Level should be at 5 mm (1/5 in.) below the gasket surface.
3. Install gaskets and covers. Tighten reservoir cover screws to 0.8-1.2 Nm (7-11 **in-lbs**).

**WARNING**

**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

4. Front brake hand lever and rear brake foot pedal must have a firm feel when applied. If not, bleed system using only D.O.T. 4 BRAKE FLUID. See 1.12 BLEEDING BRAKES.




**Figure 1-29. Rear Brake Master Cylinder Reservoir (typical)**

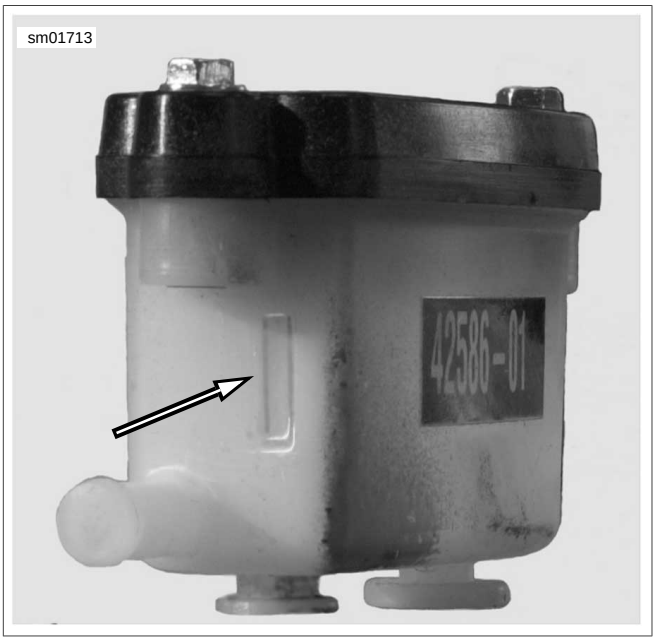



**Figure 1-30. Rear Brake Fluid Reservoir Sight Gauge (reservoir removed from motorcycle) (typical)**

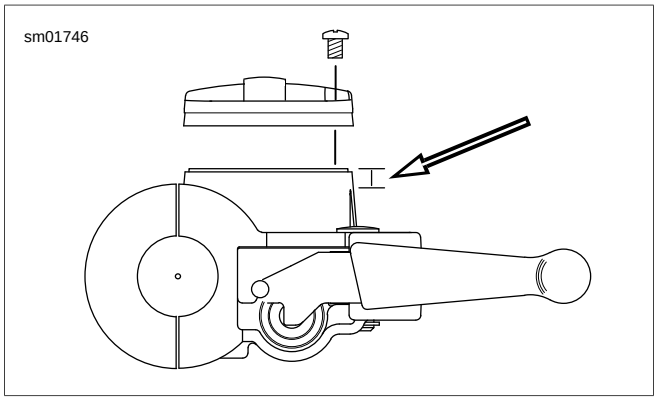



**Figure 1-31. Front Brake Master Cylinder Reservoir (MAX fluid level should be 5 mm (1/5 in.) below gasket surface)**

## REAR BRAKE PEDAL

### Pedal Adjustment

Rear brake pedal is non-adjustable.

## INSPECTION

### Brake Pads

**⚠WARNING**

**Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)**

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

See Figure 1-34. Replace brake pads if brake pad friction material on either the front or rear caliper is worn to service limit (wear indicator lines no longer visible). Always replace both pads in a caliper as a set.

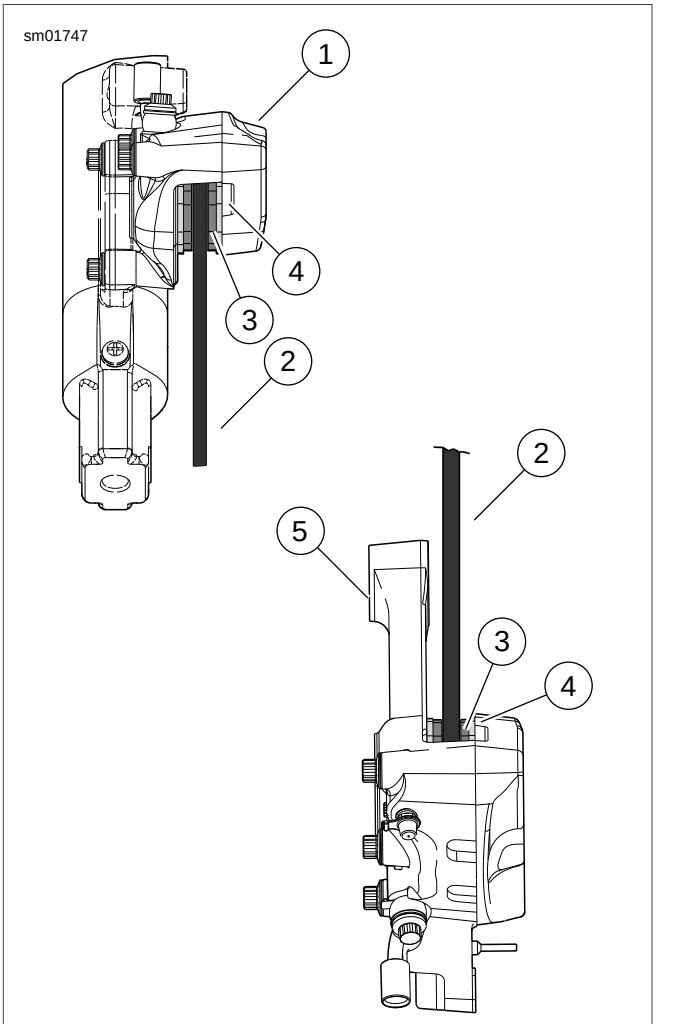
When checking the brake pads and discs, inspect the brake hoses for correct routing and any signs of damage.

### Brake Disc Thickness

The minimum brake disc (2) thickness is stamped on the side of the disc. Replace disc if badly scored.

### Brake Disc Lateral Runout and Warpage

Maximum brake disc lateral runout and warpage is 0.2 mm (0.008 in.).




1. **Front brake caliper (viewed from below)**
2. **Brake disc**
3. **Brake pads**
4. **Backing plate**
5. **Rear brake caliper (viewed from above)**

**Figure 1-32. Brake Pad Areas of Inspection (typical)**

## BRAKE PAD REPLACEMENT

### Rear Brake Caliper

1. Remove right rear upper shock bolt and pivot shock absorber away to provide necessary clearance for performing rear brake service. See 2.37 REAR SHOCK ABSORBERS for proper procedure.
2. Remove rear master cylinder reservoir cap. As pistons are pushed back into the caliper, fluid level may rise more than 12.7 mm (1/2 in.). You may have to remove fluid to allow for this.
3. Gently pry the pads back. Use steady pressure to prevent scoring the brake disc. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.

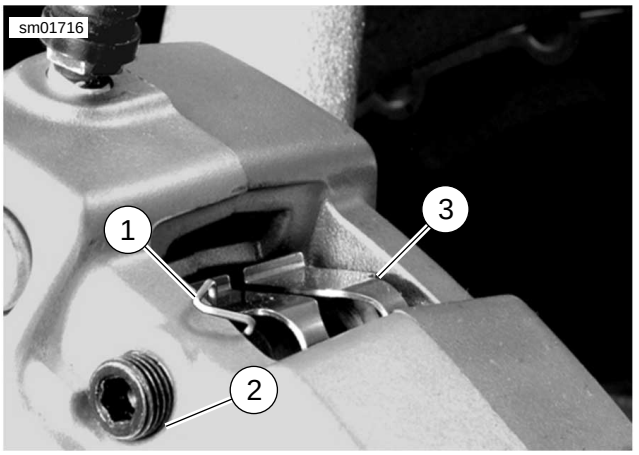
4. See Figure 1-33. Remove screen cover by pulling single prong side first, caliper pin retainer clip, and caliper pin (6 pt/5 mm). Discard pad pin and pad pin clip.

5. Using index finger, pull downward on at rear of pad directly below two-pronged side of brake pad spring to free pads from caliper. Note the pad's original orientation for replacement purposes.

*NOTE*

*If brake pad spring needs to be replaced, it is necessary to remove caliper from motorcycle. Make sure brake pad spring is seated completely for proper brake pad installation.*

6. Inspect brake pad spring for wear or damage and replace as necessary.




1. **Caliper pin retainer clip (always facing outward)**
2. **Caliper pin**
3. **Brake pad spring**

**Figure 1-33. Rear Caliper Pad Clip and Pin (6 pt/ 5 mm) (caliper cover removed for photo clarity)**

**⚠WARNING**

**Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)**

7. See Figure 1-34. Install **new** brake pads using the same orientation as the pads previously removed. Curved portion of pad must face upward. Insert square locator tab first and then pivot pin side tab upward until pad seats.

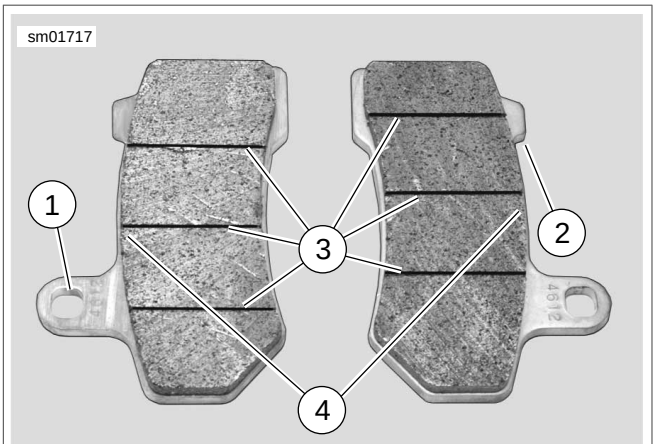
8. Verify pads have been correctly installed and seated in caliper.
   a. Install **new** pad pin (provided in set) and tighten to 8.5-11.5 Nm (75-102 **in-lbs**).
   b. Install **new** caliper pin retaining clip (provided in set) with clip facing outward.
   c. Install two pronged side of screen cover on caliper first (two pronged side faces pin side of caliper), followed by snapping the single pronged side in.

9. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads. If the front wheel is off the ground, rotate wheel to check for excessive brake pad drag.

**⚠WARNING**

**After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)**

10. Check brake fluid level in master cylinder. Push diaphragm in cover gasket in toward cover and fill to proper level if necessary using D.O.T. 4 BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 0.7-0.9 Nm (6-8 **in-lbs**).




1. **Pin side tab on backing plate**
2. **Single square locator tab on backing plate**
3. **Wear indicator lines**
4. **Curved portion**

**Figure 1-34. Brake Pad Orientation**

**⚠WARNING**

**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

11. Install shock absorber per procedure in 2.37 REAR SHOCK ABSORBERS.

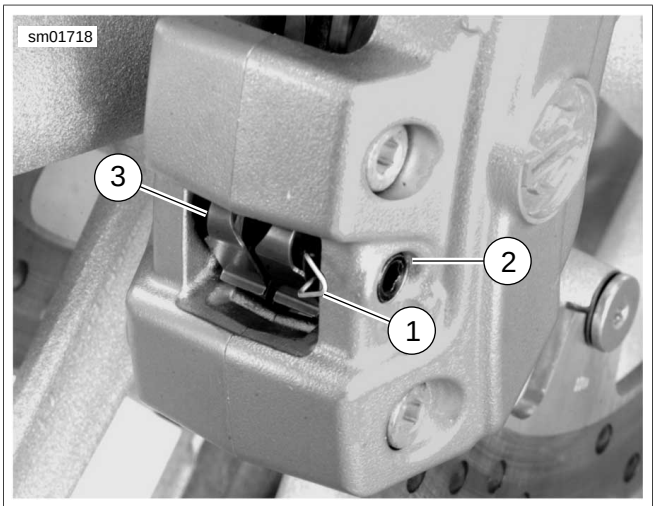
12. Test brake system.
    a. Turn ignition switch ON. Pump brake pedal to verify operation of the brake lamp.
    b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 1.12 BLEEDING BRAKES.

*NOTE*

*Avoid making hard stops for the first 160 km (100 miles). This allows the new pads to become conditioned to the brake disks.*

## Front Brake Caliper

1. Remove the front master cylinder reservoir cap. As the pistons are pushed back into the caliper, fluid level may rise more than 5.0 mm (1/5 in). You may have to remove fluid to allow for this.




1. **Caliper pin retainer clip**
2. **Caliper pin**
3. **Brake pad spring**

**Figure 1-35. Front Brake Caliper (Right Side Shown with screen cover removed)**

2. Gently pry the pads back. Use steady pressure to prevent scoring the brake disc. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.
3. See Figure 1-35. Remove screen cover by pulling single prong side first, then caliper pin retainer clip, and caliper pin (6 pt/5 mm). Discard pad pin and pad pin clip.
4. Using index finger, pull downward on at rear of pad directly below two-pronged side of brake pad spring to free pads from caliper. Note the pad's original orientation for replacement purposes.

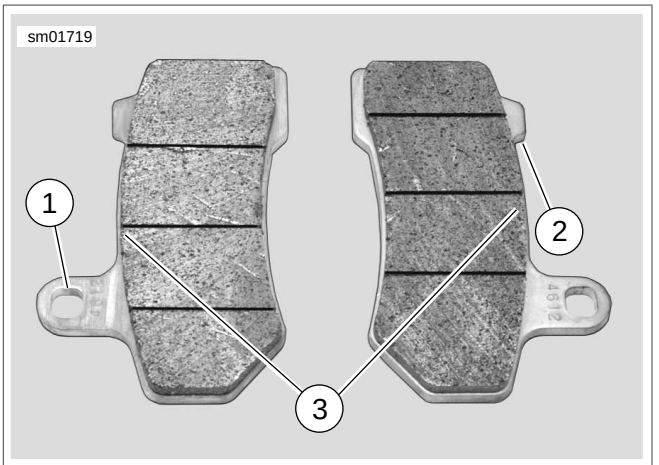
*NOTE*

*If brake pad spring needs to be replaced, it is necessary to remove caliper from motorcycle. Make sure brake pad spring is seated completely for proper brake pad installation.*

5. Inspect brake pad spring for wear or damage and replace as necessary.

**⚠WARNING**

**Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)**




1. **Pin side tab on backing plate**
2. **Single square locator tab on backing plate**
3. **Curved portion**

**Figure 1-36. Brake Pad Orientation**

6. See Figure 1-36. Install **new** brake pads using the same orientation as the pads previously removed. Curved portion of pad must face upward. Insert square locator tab first and then pivot pin side tab upward until pad seats.
   a. Install **new** caliper pin (provided in set) and tighten to 8.5-11.5 Nm (75-102 **in-lbs**)
   b. Install **new** caliper pin retainer clip (provided in set) with clip facing outwards.
7. Verify pads have been correctly installed and seated in caliper.
8. Install two pronged side of screen cover on pin side of caliper first, followed by snapping the single pronged side in.

**⚠WARNING**

**After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)**

9. Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads. If the front wheel is off the ground, rotate wheel to check for excessive brake pad drag.
10. Check brake fluid level in master cylinder. Fill to proper level if necessary using D.O.T. 4 BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 0.8-1.2 Nm (7-11 **in-lbs**).

**⚠WARNING**

**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

11. Test brake system.
    a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
    b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 1.12 BLEEDING BRAKES.

*NOTE*

*Avoid making hard stops for the first 160 km (100 miles). This allows the **new** pads to become conditioned to the brake discs.*

## GENERAL

**⚠WARNING**

**Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)**

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

**CAUTION**

**Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)**

Front brake hand lever and rear brake foot pedal must have a firm feel when brakes are applied. If not, bleed system as described.

## PROCEDURE

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48650 | DIGITAL TECHNICIAN II |
| SNAP-ON BB200A | BASIC VACUUM BRAKE BLEEDER |

*NOTES*

- *For best results use the BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200a) or equivalent tool , particularly if the brake system was completely drained. Refer to the instructions provided with the tool. If a vacuum brake bleeder is not available, use the procedure which follows. BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A)*
- *Hydraulic brake fluid bladder-type pressure equipment can be used to fill brake master cylinder through the bleeder valve. Remove master cylinder reservoir cover so that system cannot pressurize. Do not use pressure bleeding equipment when the hydraulic system is sealed with master cylinder reservoir cover and gasket in place.*
- *After bleeding brake system on ABS equipped motorcycles, confirm that brake lines are properly connected if either the ABS module or more than one brake line was removed. To accomplish this, install master cylinder reservoir cover, connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and perform "ABS Service" procedure in the "Toolbox" menu.*

1. Bleed front and rear brakes separately. Remove bleeder valve cap. Install end of a length of clear plastic tubing over caliper bleeder valve. Place opposite end in a clean container.
   a. Front brake bleeder valve-see Figure 1-37.
   b. Rear brake bleeder valve-see Figure 1-38.
2. Stand motorcycle upright. Clean and remove covers to master cylinder reservoir.
3. Add D.O.T. 4 BRAKE FLUID to master cylinder reservoir.
   a. Front brake master cylinder reservoir: Fluid level should be at MAX LEVEL. See 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
   b. Rear brake master cylinder reservoir: Fluid level should be 12.7 mm (0.5 in.) below reservoir's gasket surface. See 2.18 REAR BRAKE MASTER CYLINDER AND RESERVOIR: FORWARD CONTROLS or 2.19 REAR BRAKE RESERVOIR: MID-MOUNT CONTROLS.

*NOTE*

*Do not fill above the rear brake reservoir above the top of the sight window at the rear of the reservoir.*




**Figure 1-37. Front Brake Bleeder Valve**




**Figure 1-38. Rear Brake Bleeder Valve (typical)**

4. Depress and hold brake lever/pedal to build up hydraulic pressure.
5. Open bleeder valve slowly about 3/4-turn counterclockwise; brake fluid will flow from bleeder valve and through tubing. When brake lever/pedal has moved its full range of travel, close bleeder valve (clockwise). Allow brake lever/pedal to return slowly to its released position.
6. Repeat two previous steps until all air bubbles are purged.

*NOTE*

*Check fluid lever in master cylinder during process. Do not allow master cylinder to run dry. Refill as necessary.*

7. Remove clear plastic tubing and tighten bleeder valve to 9.0-11.0 Nm (80-97 **in-lbs**). Install bleeder valve cap.
8. Verify master cylinder fluid level.

*NOTE*

*If motorcycle is ABS equipped, and either the ABS module or more than one brake line was removed, confirm that brake system is properly connected. To accomplish this, connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and perform "ABS Setup" procedure in the "Toolbox" menu.*

**⚠WARNING**

**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

9. Test ride motorcycle. Repeat the bleeding procedure if brakes feel spongy.

## TIRES

**WARNING**

**Match tires, tubes, air valves and caps to the correct wheel rim. Contact a Harley-Davidson dealer. Mismatching can result in damage to the tire bead, allow tire slippage on the rim or cause tire failure, which could result in death or serious injury. (00023a)**

**WARNING**

**Use inner tubes on laced (wire spoked) wheels. Using tubeless tires on laced wheels can cause air leaks, which could result in death or serious injury. (00025a)**

**WARNING**

**Use only Harley-Davidson approved tires. See a Harley-Davidson dealer. Using non-approved tires can adversely affect stability, which could result in death or serious injury. (00024a)**

In addition, using tires other than those specified may adversely affect motorcycle handling.

*NOTES*

- *Tubeless tires fitted with the correct size inner tubes may be used on all Harley-Davidson laced (wire spoked) wheels. Protective rubber rim strips must be used with tubeless tires (fitted with correct size inner tubes) when mounted on laced (wire spoked) wheels.*
- *Inner tubes must not be used in radial tires and radial tires must not be used on laced (wire spoked) wheels.*
- *Tubeless tires are used on all Harley-Davidson cast and disc wheels.*
- *Tire sizes are molded on the tire sidewall. Inner tube sizes are printed on the tube.*
- *New tires should be stored on a horizontal tire rack. Avoid stacking new tires in a vertical stack. The weight of the stack compresses the tires and closes down the beads.*

Check tire pressure and tread:

- As part of the pre-ride inspection.
- At every scheduled service interval.

1. Inspect each tire for punctures, cuts and breaks.
2. Inspect each tire for wear. Replace tires before they reach the tread wear indicator bars.

*NOTE*

*Missing indicator wear bars represent less than 0.8 mm (1/32 in.) tread pattern depth remaining.*

**WARNING**

**Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)**

3. Check for proper front and rear tire pressures when tires are cold. Compare results against Table 1-10

**Table 1-10. Tire Pressures: 2008 VRSC Models**

| MODEL | LOAD | TIRE PRESSURE (COLD) | | | |
|---|---|---|---|---|---|
| | | FRONT | | REAR | |
| | | PSI | kPa | PSI | kPa |
| VRSCAW, VRSCDX | solo rider | 36 | 248 | 38 | 262 |
| | rider and passenger | 36 | 248 | 42 | 290 |
| VRSCD | solo rider | 36 | 248 | 38 | 262 |
| | rider and passenger | 36 | 248 | 40 | 276 |

## WHEEL BEARINGS

Service wheel bearings:

1. Replace when bearings exceed end play service wear limit of 0.051 mm (0.002 in.)
2. Inspect any time the wheels are removed.

- Inspect the play of the wheel bearings by finger while they are in the wheel.
- Rotate the inner bearing race and check for abnormal noise.
- Make sure bearing rotates smoothly.

3. Check wheel bearings and axle spacers for wear and corrosion. Excessive play or roughness indicates worn bearings. Replace bearings in sets only. See 2.28 SEALED WHEEL BEARINGS.

## GENERAL

The clutch is hydraulically actuated. A hand lever actuated master cylinder creates pressure in a clutch fluid line that activates a secondary clutch actuator mounted in the engine right side cover. The secondary clutch actuator piston extends and contacts the clutch release bearing to release the clutch.

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

## CHECKING CLUTCH FLUID LEVEL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-99953-99A | D.O.T. 4 BRAKE FLUID |

Though the sight gauge in the side of the reservoir will indicate a low clutch fluid level when the gauge is clear.

**⚠WARNING**

**Be sure that no lubricants or fluids get on tires, wheels or brakes when changing fluid. Traction can be adversely affected, which could result in loss of control of the motorcycle and death or serious injury. (00047d)**

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

1. Stand motorcycle upright and square handlebars to level clutch reservoir.

*NOTE*

*Do not overfill clutch reservoir. Clutch fluid volume increases with clutch wear and can damage seals causing damage to clutch or clutch system.*

2. Verify that fluid level is at FILL LEVEL marked on ledge on rear inside wall of reservoir.
3. If necessary, add D.O.T. 4 BRAKE FLUID (Part No. HD-99953-99A) to master cylinder reservoir. Fluid level should not exceed FILL LEVEL.
4. Tighten reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).

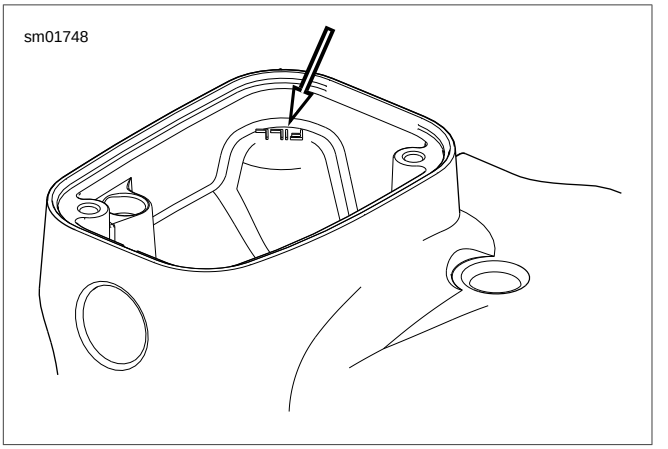



**Figure 1-39. Fill Level (Reservoir Cover Removed)**

## PROCEDURE

| PART NUMBER | TOOL NAME |
|---|---|
| HD-99953-99A | D.O.T. 4 BRAKE FLUID |

**⚠WARNING**

**Be sure that no lubricants or fluids get on tires, wheels or brakes when changing fluid. Traction can be adversely affected, which could result in loss of control of the motorcycle and death or serious injury. (00047d)**

**CAUTION**

**Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)**

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

*NOTE*

*When filling an empty clutch fluid line, a Snap-on BASIC VACUUM BRAKE BLEEDER with a fitting that mates to the secondary clutch actuator bleeder screw threads can be used to initially draw the fluid down the clutch line.*

1. Stand motorcycle upright and square handlebars to level clutch reservoir. Remove reservoir cover.

*NOTE*

*Do not overfill clutch reservoir. Clutch fluid volume increases with clutch wear and can damage seals causing damage to clutch or clutch system.*

2. If necessary, add D.O.T. 4 BRAKE FLUID (Part No. HD-99953-99A) to master cylinder reservoir. Initial fluid level should not exceed FILL LEVEL.

*NOTE*

*Loosen banjo bolt only enough to allow air bubbles to escape. Clutch fluid under pressure can squirt a steady stream several feet.*

3. While holding reservoir cover in place:
   a. Pump clutch hand lever 5 times.
   b. Hold clutch hand lever against handlebar.
   c. Hold shop towel under fitting and loosen banjo bolt.
   d. Watch banjo fitting for air bubbles.
   e. Retighten banjo fitting.
   f. Release hand lever.
4. Fill reservoir to FILL LEVEL and repeat the previous step three times or more until only a steady flow of clutch fluid escapes banjo fitting and fluid level in reservoir is at FILL LEVEL with motorcycle in an upright position.
5. Remove secondary clutch actuator cover.
6. Cover exhaust with towel and place a suitable pan under right side case to catch excess clutch fluid.
7. While holding reservoir cover in place:
   a. Pump clutch hand lever 5 times.
   b. Hold clutch hand lever against handlebar.
   c. Loosen secondary clutch actuator bleed screw.
   d. Watch bleed screw for air bubbles.
   e. Tighten bleeder screw.
   f. Release hand lever.
8. Fill reservoir to FILL LEVEL and repeat the previous step three times or more until only a steady flow of clutch fluid escapes bleeder screw and fluid level in reservoir is at FILL LEVEL with motorcycle in an upright position.

*NOTE*

*Do not overfill clutch reservoir. Clutch fluid volume increases with clutch wear and can damage seals causing damage to clutch or clutch system.*

9. Test pressure by squeezing clutch hand lever.

*NOTE*

*If continued repetition of procedure does not build pressure in line and maintain FILL LEVEL, there is a leak in the clutch system. If the leak is not visible, remove and check the secondary clutch actuator boot for leakage.*

10. Tighten fasteners as follows:
    a. Reservoir banjo bolt to 23-31 Nm (17-23 ft-lbs).
    b. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
    c. Bleed screw to 9-11 Nm (80-100 **in-lbs**).
    d. Secondary clutch actuator cover fasteners to 6-10 Nm (53-88 **in-lbs**).

11. Test ride motorcycle. Incorrect pressure can cause:
    a. Dragging clutch.
    b. Hard shifting.

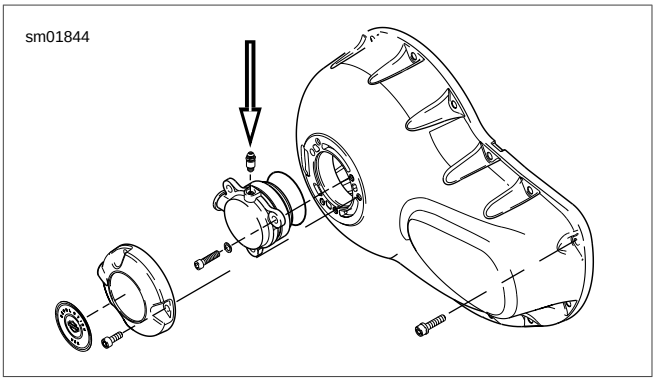



**Figure 1-40. Secondary Clutch Actuator Bleed Screw**

## INSPECTION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-35381 | BELT TENSION GAUGE |

Check rear belt deflection:

- As part of the pre-ride inspection.
- At every scheduled service interval.

*NOTES*

- *Customers may purchase belt tension gauge from an authorized Harley-Davidson dealer.*
- *Setting tension without using BELT TENSION GAUGE typically results in loose belts. Loose belts will fail due to ratcheting (jumping a tooth) which causes tensile cord crimping and breakage.*

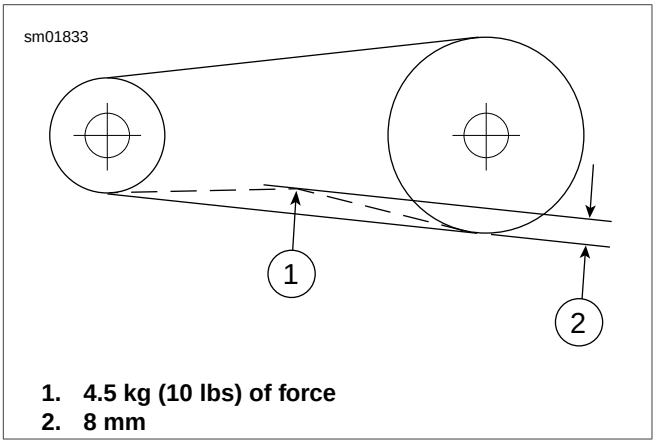
1. See Figure 1-41. Check rear belt tension with motorcycle cold, standing upright, transmission in NEUTRAL and no rider on motorcycle.
2. See Figure 1-42. Using BELT TENSION GAUGE (Part No. HD-35381) apply 4.5 kg (10 lbs) of force upward.
3. Verify that the drive belt deflects 8 mm for all models.

*NOTE*

*Belt deflection window on the debris deflector is graduated in 2 mm increments.*




**Figure 1-41. Belt Tension Gauge (HD-35381)**




**1. 4.5 kg (10 lbs) of force**
**2. 8 mm**

**Figure 1-42. Checking Belt Deflection**

4. If belt adjustment is necessary, see Figure 1-43. Remove snap ring (1) and loosen axle nut (2) on right side of motorcycle.

*NOTE*

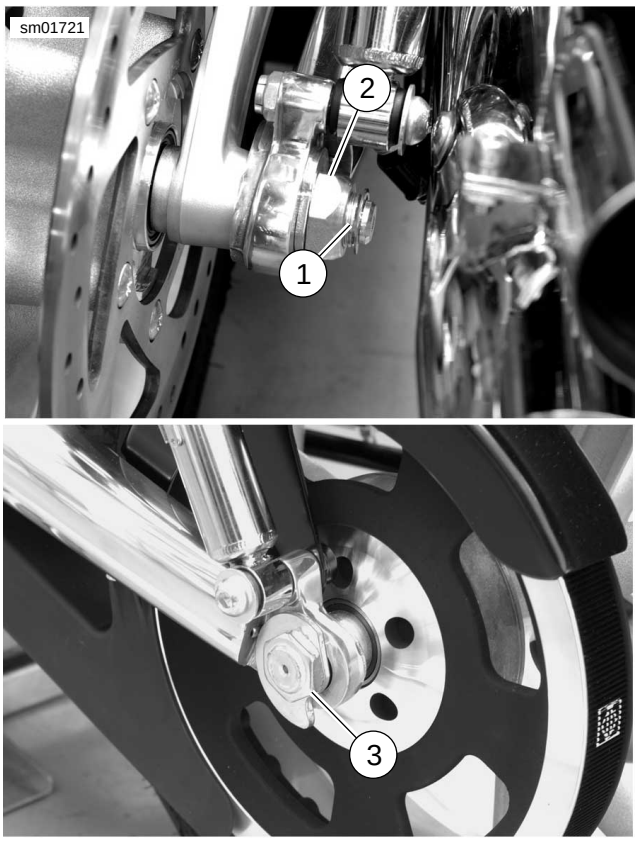
*The left cam is welded to the axle and the right cam is keyed to the axle. Clockwise rotation of axle will tighten belt. Counter-clockwise rotation will loosen belt.*

5. Adjust belt tension on left side by turning the axle adjustment eccentric (3) until the specification in step 2 is achieved.

**⚠WARNING**

**Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)**

6. Tighten rear axle nut (2).
   a. Tighten axle nut (2) to 190-203 Nm (140-150 ft-lbs).
   b. Install snap ring (1).




1. **Snap ring (right side)**
2. **Rear axle nut (right side)**
3. **Adjustment eccentric (left side)**

**Figure 1-43. Axle Adjusters (typical)**

## GENERAL

When a drive belt is replaced for any reason other than stone damage, it is recommended that the transmission and rear sprockets also be replaced to increase the longevity of the new drive belt. In the case of stone damage, inspect sprockets for damage and replace as required.

**⚠WARNING**

**Never bend belt forward into a loop smaller than the drive sprocket diameter. Never bend belt into a reverse loop. Over bending can damage belt resulting in premature failure, which could cause loss of control and death or serious injury. (00339a)**

## CLEANING

Keep dirt, grease, oil, and debris off the belt and sprockets. Clean the belt with a rag slightly dampened with a light cleaning agent.

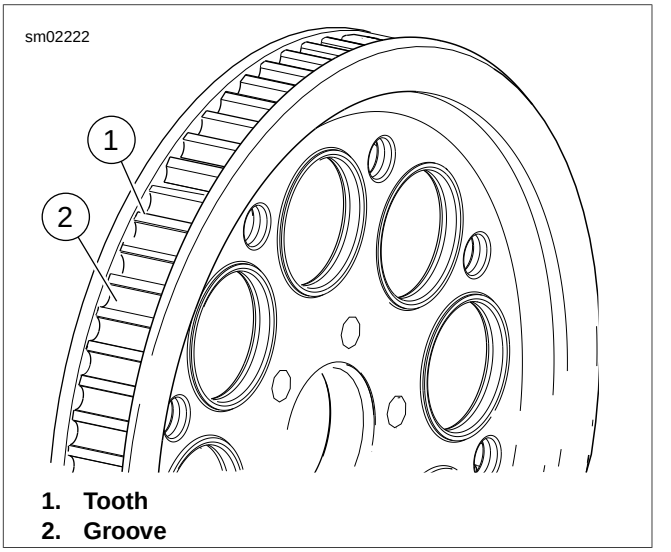
## INSPECTION

### Sprockets

*NOTE*

*If chrome chips or gouges to rear sprocket are large enough to be harmful, they will leave a pattern on the belt face.*

1. See Figure 1-44. Inspect each tooth (1) of rear sprocket for:
   a. Major tooth damage.
   b. Large chrome chips with sharp edges.
   c. Gouges caused by hard objects.
   d. Excessive loss of chrome plating (see next step).
2. To check if chrome plating has worn off, drag a scribe or sharp knife point across the bottom of a groove (2) (between two teeth) with medium pressure.
   a. If scribe or knife point slides across groove without digging in or leaving a visible mark, chrome plating is still good.
   b. If scribe or knife points digs in and leaves a visible mark, it is cutting the bare aluminum. A knife point will not penetrate the chrome plating.
3. Replace rear sprocket if major tooth damage or loss of chrome exists.




**1. Tooth**
**2. Groove**

**Figure 1-44. Rear Sprocket**

### Rear Belt

See Figure 1-45. Inspect drive belt for:

- Cuts or unusual wear patterns.
- Outside edge bevelling (8). Some bevelling is common, but it indicates that sprockets are misaligned.
- Outside ribbed surface for signs of stone puncture (7). If cracks/damage exists near edge of belt, replace belt immediately. Damage to center of belt will require belt replacement eventually, but when cracks extend to edge of belt, belt failure is imminent.
- Inside (toothed portion) of belt for exposed tensile cords (normally covered by nylon layer and polyethylene layer). This condition will result in belt failure and indicates worn transmission sprocket teeth. Replace belt and transmission sprocket.
- Signs of puncture or cracking at the base of the belt teeth. Replace belt if either condition exists.
- Replace belt if conditions 2, 3, 6 or 7 (on edge of belt) exist.

*NOTE*

*Condition 1 may develop into 2 or 3 over time. Condition 1 is not grounds for replacing the belt, but it should be watched closely before condition 2 develops which will require belt replacement.*

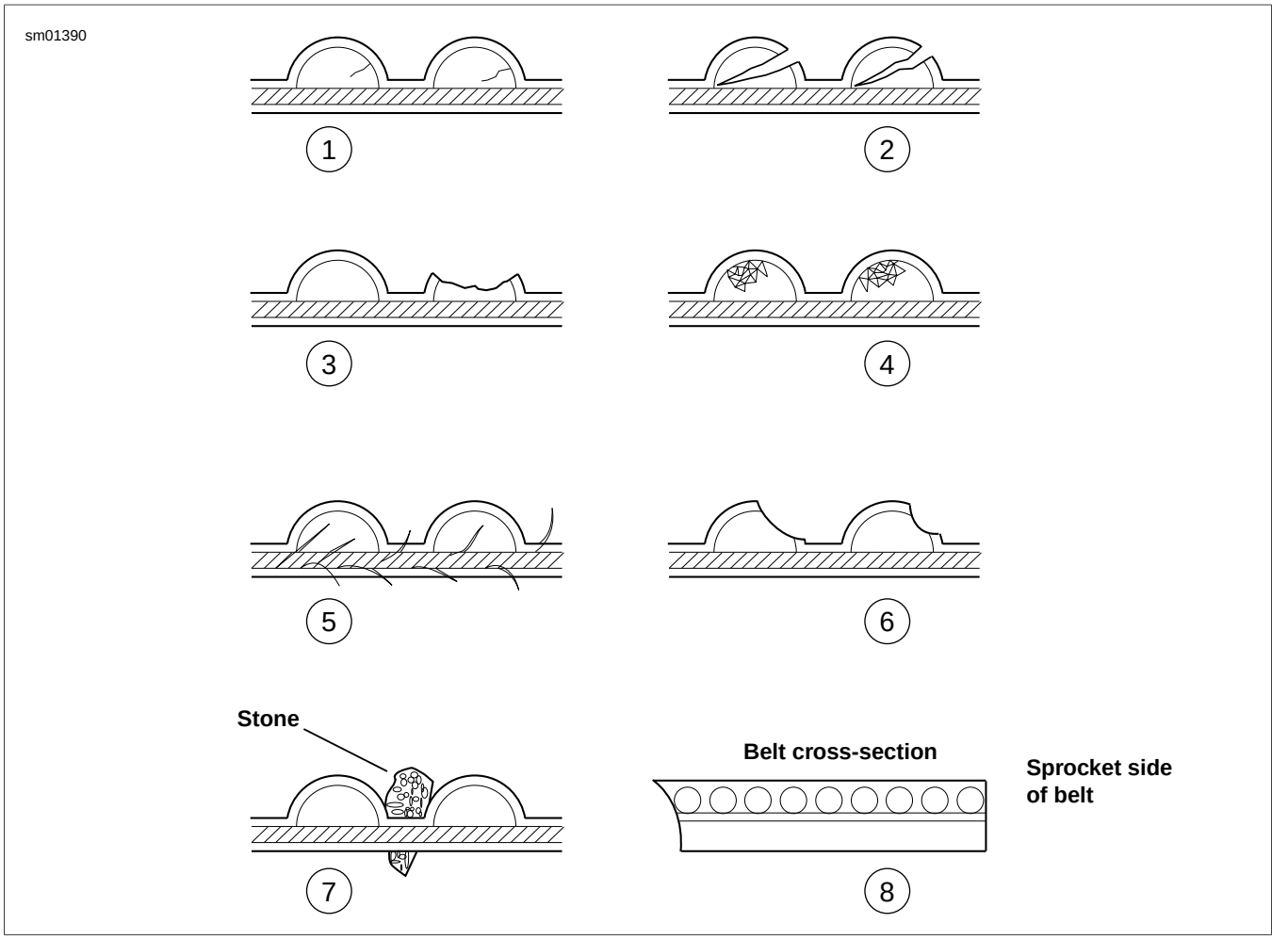



**Figure 1-45. Drive Belt Wear Patterns**

**Table 1-11. Drive Belt Wear Analysis**

| PATTERN | CONDITION | REQUIRED ACTION |
|---|---|---|
| 1 | Internal tooth cracks (hairline) | OK to run, but monitor condition. |
| 2 | External tooth cracks | Replace belt. |
| 3 | Missing teeth | Replace belt. |
| 4 | Chipping (not serious) | OK to run, but monitor condition. |
| 5 | Fuzzy edge cord | OK to run, but monitor condition. |
| 6 | Hook wear | Replace belt and sprocket. |
| 7 | Stone damage | Replace belt if damage is on the edge. |
| 8 | Bevel wear (outboard edge only) | OK to run, but monitor condition. |

## REPLACEMENT

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.

*NOTE*

*VRSC models equipped with the 240 mm rear tire have a spacer on each front sprocket cover fastener. Note locations of spacers and make sure to install spacers during assembly.*

2. See Figure 1-47. Remove drive sprocket cover (6) fasteners (9) and washers (8). Grommets (7) and bushings (10) should stay with cover (6).
3. See Figure 1-47. Loosen locking bolts (5) holding drive sprocket (3) to drive sprocket flange (4).
4. Block motorcycle underneath frame so weight of motorcycle is off of rear wheel.
5. Remove fastener holding lower debris deflector to Swingarm. Pull debris deflector rearward off of rubber grommet. See 2.36 BELT GUARD AND DEBRIS DEFLECTOR.
6. Loosen left lower shock bolt until belt guard is free and pull belt guard rearward off of rubber grommets.
7. Remove axle retaining ring and loosen axle nut and adjuster from right side of axle.
8. Relieve belt tension by rotating axle adjusters.

*NOTE*

*Polished aluminum wheels can be scratched or damaged when slid out of and into the Swingarm. Exercise caution to avoid dragging wheel and sprocket surfaces against Swingarm components.*

9. Remove shock bolt and swing shock up and out of the way.
10. See Figure 1-47. Slip drive belt (2) off wheel sprocket (1) and drive sprocket (3).
11. Inspect both drive and wheel sprocket for indicators of wear, misalignment, and damage. See 1.17 REAR BELT AND SPROCKETS.

*NOTES*

- *When a drive belt is replaced for any reason other than stone damage, it is recommended that the drive and wheel sprockets also be replaced to increase the longevity of the new drive belt. In the case of stone damage, inspect sprockets for damage and replace as required.*
- *Do not remove the drive sprocket flange nut.*

*NOTE*

12. Remove locking bolts (5) from drive sprocket. Discard bolts (5).
13. Rotate drive sprocket (3) to fit spoke pattern of flange (4) and remove sprocket (3).

*NOTE*

*Make sure threads are free of old thread lock material before installing **new** locking bolts.*

14. Install drive sprocket (3) by matching spokes of drive sprocket to open spaces of drive sprocket flange (4) and rotate drive sprocket (3) to align sprocket bolt holes behind mounting flange (4) bolt holes.
15. Install and tighten three **new** locking bolts (5) to 88-102 Nm (65-75 ft-lbs).

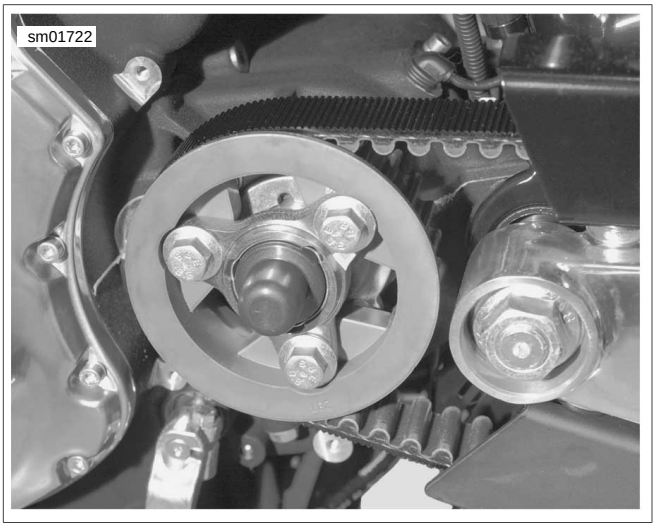
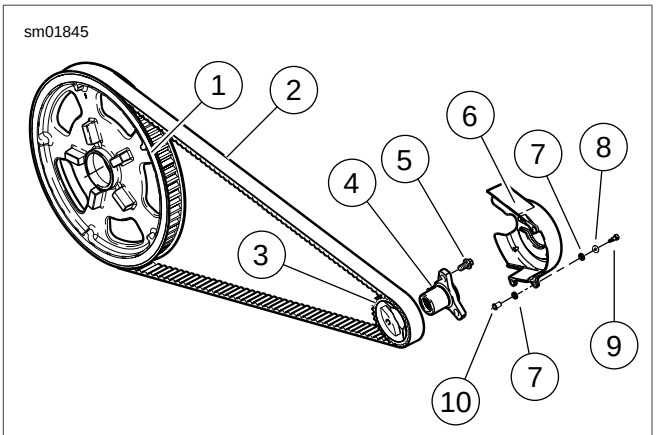



**Figure 1-46. Drive sprocket**




1. **Wheel sprocket**
2. **Drive belt**
3. **Drive sprocket**
4. **Drive sprocket flange**
5. **Locking bolts**
6. **Drive sprocket cover**
7. **Grommet (2)**
8. **Washer**
9. **Fastener**
10. **Bushing**

**Figure 1-47. Sprocket and Belt Components (typical)**

16. Remove the rear wheel and replace the wheel sprocket. See 2.27 REAR WHEEL.

17. See Figure 1-47. Fit replacement belt (2) around drive sprocket (3) and over wheel sprocket (1).
18. Rotate axle adjusters to seat drive belt on sprockets. Tighten axle nut to hold in place.
19. Slide belt guard slots onto rubber grommet.
20. Thread shock mount bolt into belt guard and tighten shock mount bolt. See 2.37 REAR SHOCK ABSORBERS.
21. Slide debris deflector slots on to its corresponding rubber grommet. Install debris deflector fastener and tighten to 6-10 Nm (53-88 **in-lbs**).
22. Measure belt guard to drive sprocket clearance.
23. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.
24. Verify axle alignment and check belt deflection. See 1.16 REAR BELT DEFLECTION.
25. Use a wrench to rotate rear axle adjuster until drive belt deflection is within specifications.

**⚠WARNING**

**Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)**

26. Tighten axle nut to 190-203 Nm (140-150 ft-lbs).
27. Install snap ring.
28. Install belt drive sprocket cover (6). Tighten cover fasteners (9) to 6-10 Nm (53-88 **in-lbs**).
29. Install maxi-fuse and right side cover.

## REPLACEMENT

| PART NUMBER | TOOL NAME |
|---|---|
| DC2001 | SNAP-ON METRIC BOLT GRIP PULLER SET |
| HD-45331-A | FINAL DRIVE SPROCKET FLANGE LOCKING TOOL |
| HD-45331-A | FINAL DRIVE SPROCKET FLANGE LOCKING TOOL |
| HD-45332 | FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER |

*NOTE*

*The drive sprocket flange can be replaced on the transmission output shaft with the shaft removed from the engine cases. See 7.6 OUTPUT SHAFT, Disassembly - 2nd Gear End under 7.6 OUTPUT SHAFT. The following procedure replaces the drive sprocket flange without removing the engine from the motorcycle.*

1. Remove the fasteners and the drive sprocket cover. See 1.18 DRIVE BELT REPLACEMENT.
2. With rear wheel on ground, loosen retaining bolts holding drive sprocket to drive sprocket flange.
3. Support motorcycle with rear wheel off the ground. Remove snap ring and loosen rear wheel axle nut. Move wheel forward and slip belt off wheel sprocket. Pull belt off of drive sprocket.
4. Remove drive sprocket retaining bolts from drive sprocket. Discard bolts.
5. Rotate sprocket to fit spoke pattern of mounting flange and remove sprocket.
6. See Figure 1-49. Use awl to remove the flange nut lock ring (4) from the drive sprocket flange (1).
7. Remove the plastic cap (5).
8. Fit the lock pins of the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A) to the sprocket mounting holes in the drive sprocket flange (1).

*NOTE*

*Do not use an impact wrench to remove or install the drive sprocket flange nut. Damage to the threads on the output shaft of the transmission can result.*

9. Fit a thin-wall 30 mm socket onto the flange nut.
10. See Figure 1-48. Holding the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A) with a 1/2 in. drive breaker bar in the square hole, loosen and remove the flange nut.

*NOTE*

*Drive sprocket flange nut is one time use only, but do not discard at this time. Retain removed nut to pull flange on shaft during assembly.*

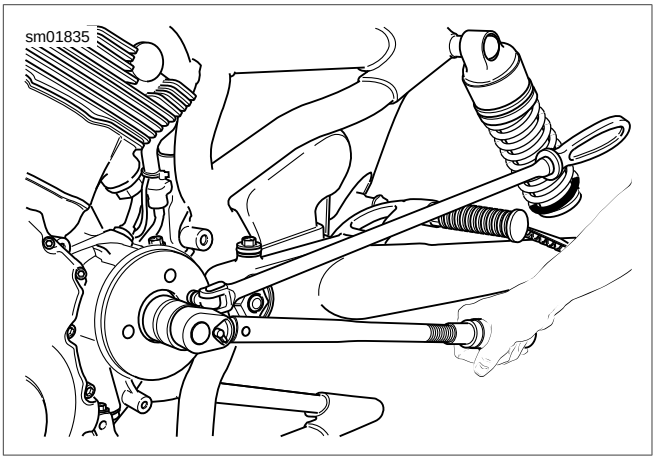
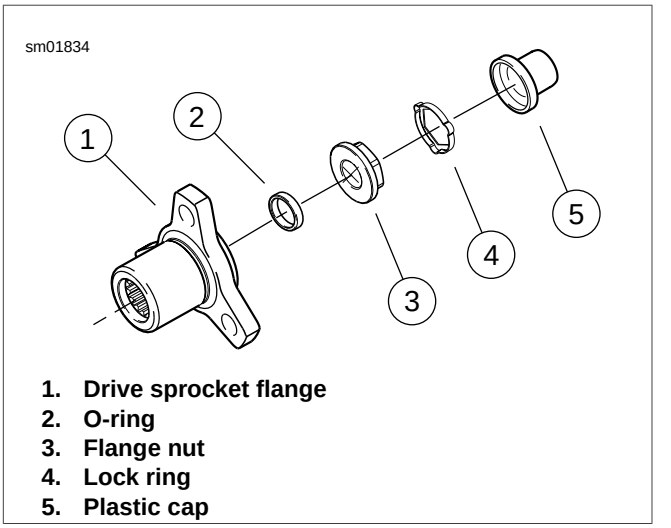



**Figure 1-48. Loosen Output Shaft Nut with Final Drive Sprocket Flange Locking Tool (HD-45331-A) (typical)**




1. **Drive sprocket flange**
2. **O-ring**
3. **Flange nut**
4. **Lock ring**
5. **Plastic cap**

**Figure 1-49. Drive Sprocket Flange Components**

11. Obtain three 3/8 x 5 in. bolts with washers and nuts. Install a SNAP-ON METRIC BOLT GRIP PULLER SET (Part No. DC2001) onto the flange and shaft. Remove the drive sprocket flange.

*NOTE*

*The drive sprocket flange seal is held in place with a retainer. It is recommended that the seal be replaced any time the drive sprocket flange is removed.*

12. Remove the fasteners and the seal retainer.
13. Remove and discard the flange seal and O-ring.
14. Install a **new** O-ring and **new** flange seal in the seal retainer. Lubricate the flange seal with Harley-Davidson Motorcycle oil 20W50.
15. Slide the seal retainer on the drive sprocket flange. and slide the splined drive sprocket flange onto the output shaft.

16. Install the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A). Hold the tool with a 1/2 in. drive extension.

*NOTES*

- *Do not attempt to drive flange on with a hammer. Damage to the output shaft can result.*
- *Do not use an impact wrench to remove or install the drive sprocket flange nut. It can damage the threads on the output shaft of the transmission.*

17. Use the old flange nut to pull the drive sprocket flange onto the shaft.
18. Remove and discard the old flange nut.
19. Install a **new** O-ring behind the flange nut and install the **new** flange nut.
20. Tighten the flange nut to 160 Nm (118 ft-lbs).
21. Install fasteners in seal retainer and tighten in a alternating pattern to 23 Nm (17 ft-lbs).
22. See Figure 1-49. Position locking ring (4) over the flange nut (3).
23. With three 3/8x5 in. bolts with washers and nuts and install a Metric Bolt Grip Puller Set (Snap-on Part No. CJ2001) onto the flange and shaft.

*NOTES*

- *Never use a hammer to hit on the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (Part No. HD-45332). Damage to output shaft bearing could result.*
- *Do not use an impact wrench to remove or install the drive sprocket flange nut. It can damage the threads on the output shaft of the transmission.*

24. Turn screw down against the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (Part No. HD-45332) to crimp lock ring in position.
25. Cap flange nut.
26. Install drive sprocket by matching spokes of drive sprocket to open spaces of mounting flange and rotating sprocket to align sprocket bolt holes behind mounting flange bolt holes.
27. Install and tighten three **new** locking bolts to 88-102 Nm (65-75 ft-lbs).
28. Install the belt and the drive sprocket cover. See 1.18 DRIVE BELT REPLACEMENT.

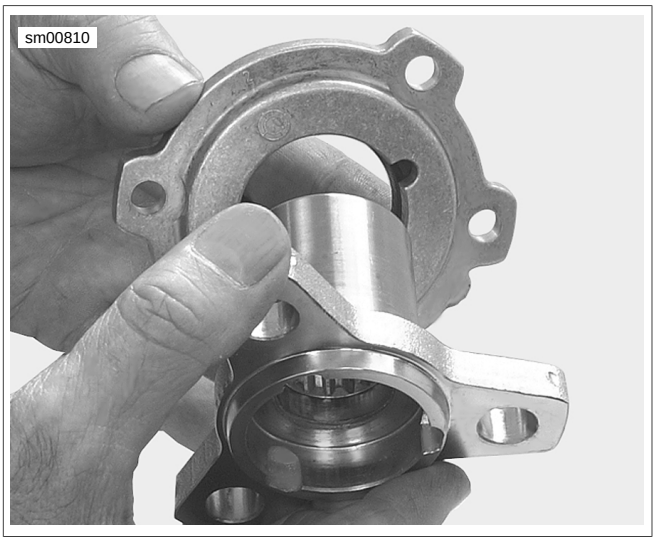



**Figure 1-50. Seal Retainer and Output Flange**

## REAR SHOCK ABSORBERS: VRSC MODELS

| PART NUMBER | TOOL NAME |
|---|---|
| 94700-52C | SPANNER WRENCH |

### General

See Figure 1-51. The rear shock absorber spring preload can be adjusted for the weight the motorcycle is to carry and has five preload graduations. Notice the adjustment settings as you turn the collar.

### Adjustment

**⚠WARNING**

**Be sure both shock absorbers are adjusted to same preload position. Improper adjustment can adversely affect stability and handling, which could result in death or serious injury. (00036a)**

The average weight solo rider might use the extended spring preload position (adjustment setting 1 or 2).

1. Place the shock absorber adjustment tool around the lower collar of the shock absorber.
2. Turn the collar clockwise (toward higher numbers) to increase the preload or pressure.

Use the adjustment setting numbers as a reference for equal adjustment of shock absorbers on both the right and left side of the motorcycle. A heavy solo rider might require additional preload or pressure (adjustment setting 3).

**CAUTION**

**Do not turn the shock absorber adjustment collar counterclockwise beyond adjustment setting 1. Doing so may result in equipment damage. (00166a)**

Adding a passenger may require maximum preload (adjustment setting 5).

Turn the collar counterclockwise to decrease the preload or pressure.

See Figure 1-51. To adjust the rear shock absorber spring preload, turn the spring adjusting cam to the desired position with a spanner wrench. When returning to off-cam position, cams should be backed off in opposite direction. A SPANNER WRENCH (Part No. 94700-52C) is available from your Harley-Davidson dealer.




**Figure 1-51. Rear Shock Adjustment (typical)**

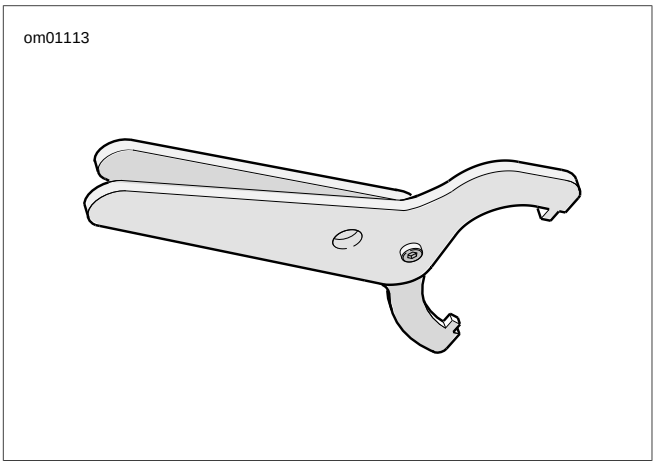



**Figure 1-52. Spanner Wrench (HD-94700-52C)**

## ADJUSTMENT (FALL-AWAY)

1. Support motorcycle in an upright position so the front end is completely suspended and the vehicle is level.
2. Remove all accessory weight and P&A parts, such as a windshield, or any part that may influence the way the front end swings.

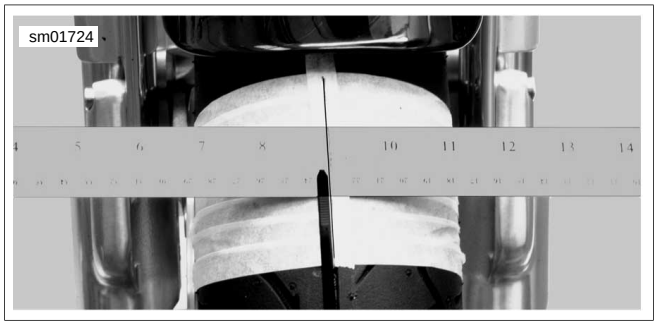



**Figure 1-53. Fall-Away Measurement**

3. See Figure 1-53. Place masking tape on front tire. Tape ruler over taped area on front tire and draw a line on the masking tape even with the ruler center.
4. Install a pointer so the base is stationary on the floor and the pointer indicates the center of the ruler. The front end should be straight ahead, however the balance point may be slightly off center.




**Figure 1-54. Pinch Bolts**

5. See Figure 1-54. Loosen lower fork stem pinch bolts.
6. Check steering fall-away.
   a. Tap the tire on one side until the front end begins to "fall-away." Record mark on ruler.
   b. Tap the tire on the opposite side until the front end begins to "fall-away." Record mark on ruler.
   c. Measure distance between marks or subtract reading at one mark from reading at other.
7. The distance between the "fall-away" marks must be 51-102 mm (2.0-4.0 in.). Tighten or loosen adjuster nut until the measurement is within limits.
   a. See Figure 1-55. Remove fork stem cap, and loosen fork stem nut.
   b. If the distance is more 102 mm (4.0 in.) loosen adjusting nut.
   c. If it is less than 51 mm (2.0 in.), tighten the adjusting nut.

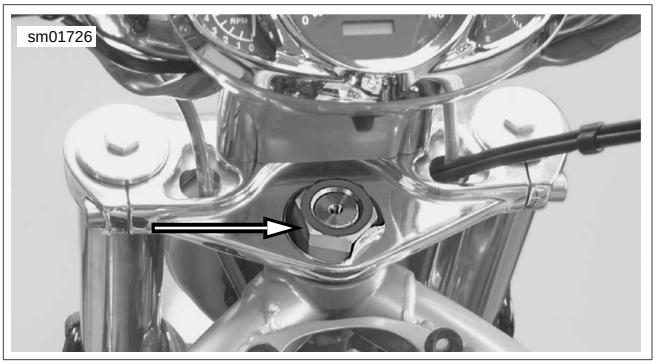



**Figure 1-55. Steering Head Fork Stem Nut**

*NOTE*

*Tighten fork stem nut to 95-108 Nm (70-80 ft-lbs) each time fall-away is checked.*

*If adjustment seems to have no impact, check to see if fork tubes are stuck in clamps. If necessary, strike triple clamps with a dead blow hammer to free. Retest steering head bearing tension after freeing forks.*




**Figure 1-56. Tighten Steering Head**

8. Tighten fork stem bracket pinch bolts to 41-47 Nm (30-35 ft-lbs).
9. Repeat the "fall-away" procedure to be sure the adjustment is correct.
10. Install fork stem cap.

## GENERAL

**WARNING**

**Disconnecting spark plug cable with engine running can result in electric shock and death or serious injury. (00464b)**

The spark plugs have been carefully selected for the performance characteristics of the VRSC engine. Use only **10R12A** spark plugs in the VRSC engine.

*NOTE*

*Use only Harley-Davidson spark plugs made for the VRSC. Use of other spark plugs can affect the running characteristics of the engine and could result in engine damage.*

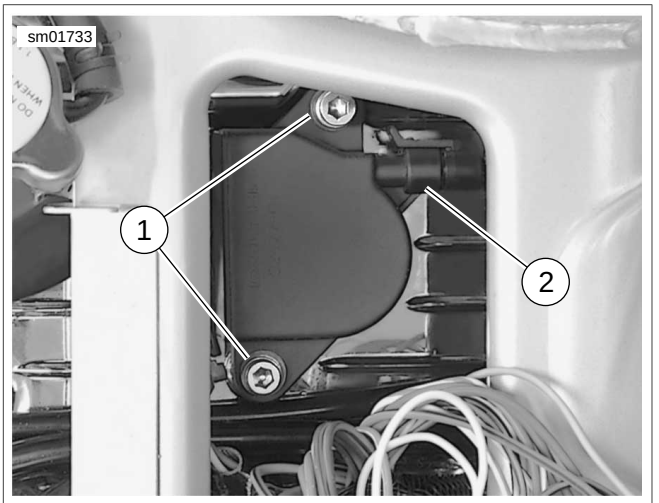
## REMOVAL/INSPECTION

1. After the engine has cooled to room temperature remove airbox assembly. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
2. Gain access to rear plug coil.
   a. See Figure 1-57. Remove coolant overflow bottle by pulling bottle upward and rocking bottle free of mounting grommets.




**Figure 1-57. Coolant Bottle**

3. See Figure 1-58. Remove rear coil fasteners (1).
4. Detach connector (2) [83R] at rear coil, [83F] at front coil.
5. Pull coil and boot assembly straight up to disconnect spark plug.
6. Using a spark plug socket with plug retaining sleeve, remove rear spark plug.
7. Remove battery for access to front spark plug. See 1.9 BATTERY MAINTENANCE.
8. Remove front spark plug.




1. **Fasteners**
2. **Connector [83R]**

**Figure 1-58. Rear Cylinder Coil Location (typical)**

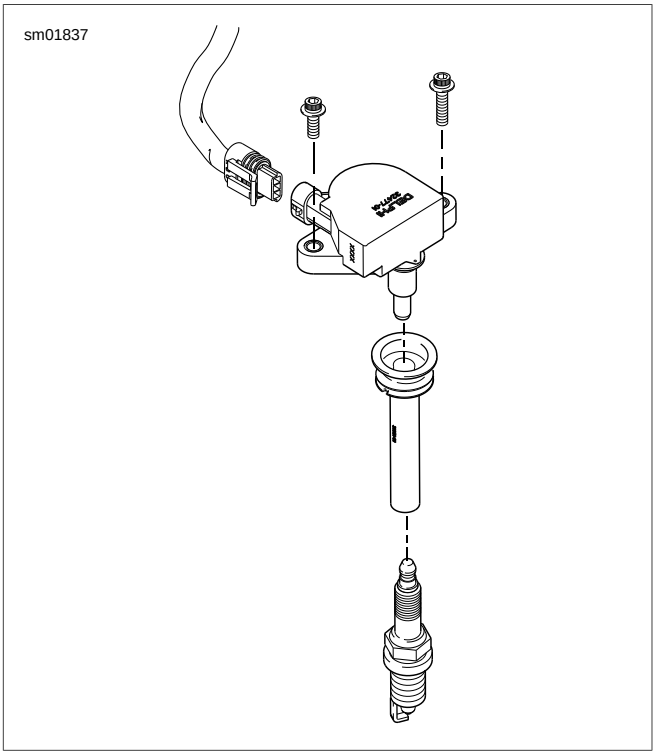


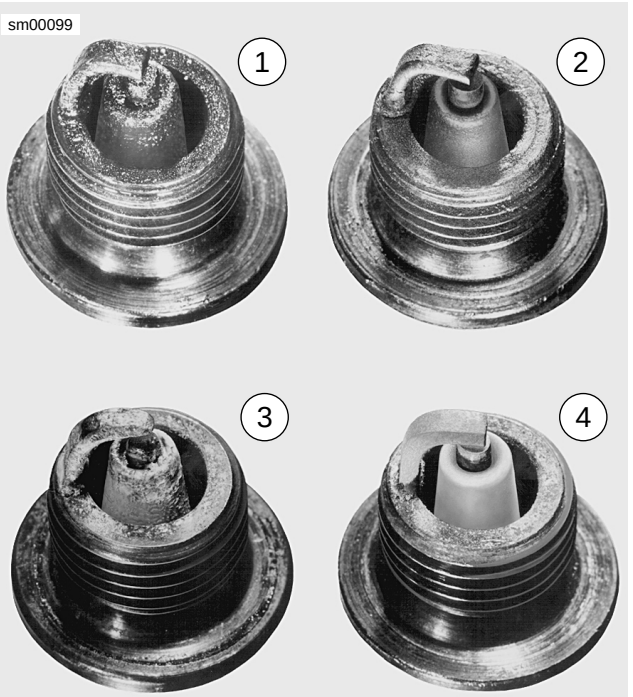

**Figure 1-59. Plug Top Coil**

9. See Figure 1-60. Compare your observations of the plug deposits with the descriptions provided.
   a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.
   b. A dry, fluffy or sooty black deposit indicates an air-fuel mixture that is too rich, engine idling for excessive periods of time and/or enrichener usage for excessive periods of time.
   c. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot-running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed misfiring. A plug with eroded electrodes, heavy deposits or a cracked insulator must be replaced.
   d. A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals.

**⚠WARNING**

**Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)**

10. If the plugs require cleaning between tune-ups, proceed as follows:
    a. Degrease firing end of spark plug using ELECTRICAL CONTACT CLEANER. Dry plug with compressed air.
    b. Use a thin file to flatten spark plug electrodes. A spark plug with sharp edges on its electrodes requires 25-40% less firing voltage than one with rounded edges.
    c. If the plugs cannot be cleaned, replace with No. **10R12A** spark plugs.
11. Check electrode gap with a wire-type feeler gauge. Bend the outside of the electrode so only a slight drag on the gauge is felt when passing it between electrodes. Proper gap measurement is 0.89 mm (0.035 in.).
12. Check condition of threads on cylinder head and plug. If necessary to remove deposits, apply penetrating oil and clean out with a thread chaser.




1. **Oil-fouled**
2. **Sooty black deposits**
3. **Overheated**
4. **Balanced combustion**

**Figure 1-60. Typical Spark Plug Deposits**

## INSTALLATION

1. Apply LOCTITE® ANTI-SEIZE to plug threads. Install and tighten to 23 Nm (17 ft-lbs).
2. Install coil and boot assembly over spark plug with wiring connector facing rear of motorcycle.
3. Insert coil fasteners with long fastener used on left side. Tighten to 9.7 Nm (86 **in-lbs**).
4. Mate connectors [83R] and [83F].
5. Install battery after installing front plug and coil. See 1.9 BATTERY MAINTENANCE.
6. Install rear plug and coil and coolant overflow bottle.
   a. Install coolant overflow bottle.
7. Install airbox assembly. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

## GENERAL

Inspect and lubricate the front brake lever, clutch hand lever, throttle control cables, and jiffy stand.

## CABLES AND HAND LEVERS

| PART NUMBER | TOOL NAME |
|---|---|
| HD-94968-85TV | SUPER OIL |

Inspect and lubricate throttle cables. See 1.24 THROTTLE CABLES for throttle cables.

Use SUPER OIL (Part No. HD-94968-85TV) for hand levers.

## JIFFY STAND

Clean and lubricate the jiffy stand.

If service is on muddy or dusty roads, clean and lubricate at shorter intervals.

## FUEL SYSTEM LINES AND FITTINGS

1. Inspect the fuel system lines.
2. Check the fuel system lines and fittings for leaks.
3. See Figure 1-61. Check fuel system lines for chafing against frame components.

## HYDRAULIC LINES

1. Inspect hydraulic brake fluid lines and clutch fluid lines for leaks.
2. Check inside clear plastic tubing over braided lines for leakage inside tubing.




**Figure 1-61. Fuel Lines (typical)**

## INSPECTION

**WARNING**

**Never route throttle cable over the battery. Fire due to short circuit could occur and cause death or serious injury. Throttle cables must be routed alongside battery, between hold down strap and coolant overflow bottle. (00224a)**

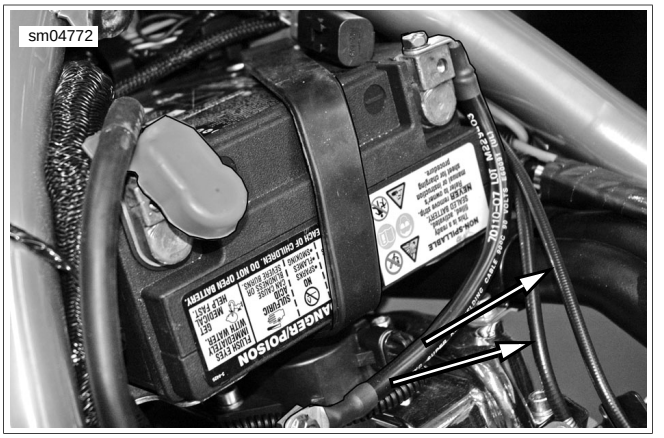



**Figure 1-62. Throttle Cable Routing**

## LUBRICATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-94968-85TV | SUPER OIL |

1. See Figure 1-63. Turn the cable adjusters (2, 4) and jam nuts (3) as short as they will go.
2. Remove two screws (1) to separate the upper handlebar housing from the lower housing.
3. Use a screwdriver to rotate each ferrule and remove cable from the throttle grip.
4. Slide the throttle grip off the handlebar.
5. Apply a light coat of graphite to the handlebar and reinstall throttle grip.
6. Put one or two drops of SUPER OIL (Part No. HD-94968-85TV) into the housing of each cable.
7. Remove the airbox cover and the airbox and inspect cable routing. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
8. Install the airbox and airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
9. Assemble the handlebar housing and tighten both screws (1) to 4.0-5.1 Nm (35-45 **in-lbs**).

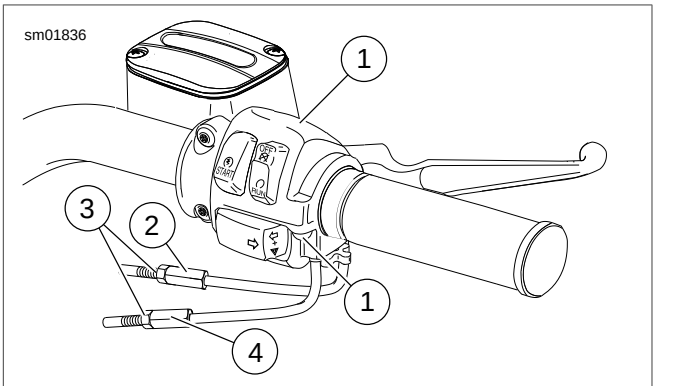
## ADJUSTMENT

1. See Figure 1-63. Turn the cable adjusters (2, 4) and jam nuts (3) as short as they will go. Both cables should have zero adjustment at the start of this procedure.
2. Point the front wheel straight ahead.
   a. Rotate the throttle grip wide open and hold it there.
   b. Turn the throttle cable adjuster (2), lengthening the sleeve, until the throttle cam just touches the cam stop.
   c. Tighten the throttle cable adjuster (2) an additional 2 to 3 full turns.
3. Turn the front wheel full right.
4. Turn the idle cable adjuster (4), lengthening the sleeve until the cable housing just touches the bottom of the pocket retainer on the throttle body linkage.

**WARNING**

**Pinched throttle cables can restrict throttle response, which could result in loss of control and death or serious injury. (00423b)**

5. Check adjustment.
   a. Rotate the throttle grip and release to be sure the cable returns sharply to idle position. If the cable does not return to idle, turn idle cable adjuster (4), shortening the sleeve until correct adjustment is reached.
   b. Verify that the throttle operates without binding.
   c. Verify sufficient free play.
6. Tighten both jam nuts (3).




1. **Screws**
2. **Throttle cable adjuster**
3. **Jam nuts**
4. **Idle cable adjuster**

**Figure 1-63. Throttle Cable Adjusters**

## LASH MEASUREMENT

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-47181 | ANGLE BLADE FEELER GAUGE SET |

1. Remove airbox assembly. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
2. Remove battery. See 1.9 BATTERY MAINTENANCE.
3. Remove starter solenoid from battery box.
4. Remove all clipped connectors from battery caddy, disconnect and remove starter solenoid.
5. See Figure 1-64Remove battery and tray components from motorcycle.
   a. Remove positive (4) and negative (13) battery cables.
   b. Remove strap (1).
   c. Remove battery (6) from motorcycle.
   d. Remove left side battery caddy (5) and right side battery caddy (11).
   e. Remove fasteners (7) and (8) and remove battery tray (9) from motorcycle.

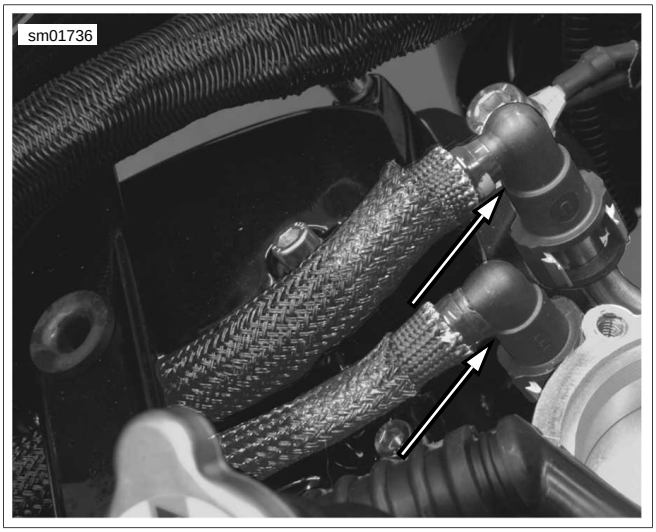
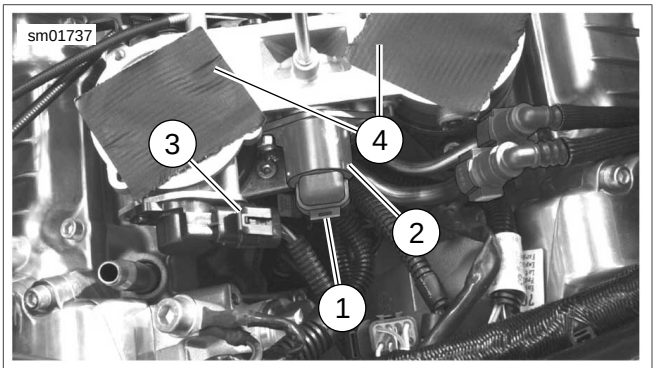


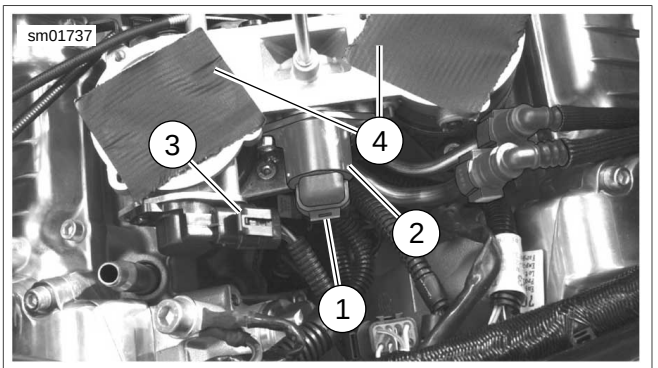

**Figure 1-64. Fuel Line**




1. **IAC sensor connector [87B]**
2. **Idle air control (IAC)**
3. **Throttle position (TP) sensor connector [88B]**
4. **Injector intakes (covered)**

**Figure 1-65. Throttle Body Electrical Connectors**

6. See Figure 1-64. Remove fuel lines.
   a. At the fuel rail, disconnect pressure fuel line and return fuel line by pressing blue buttons with thumb and first finger.
   b. Remove fittings at the fuel tank.
   c. Pull fuel lines away from the throttle body.
   d. Remove ground wires.
7. Remove front and rear coils. See 1.22 SPARK PLUGS AND COIL.
8. Disconnect idle air control (IAC) connector [87B] from throttle body.
9. Disconnect throttle position (TP) sensor connector [88B] from throttle body.




1. **IAC sensor connector [87B]**
2. **Idle air control (IAC)**
3. **Throttle position (TP) sensor connector [88B]**
4. **Injector intakes (covered)**

**Figure 1-66. Throttle Body Electrical Connectors**

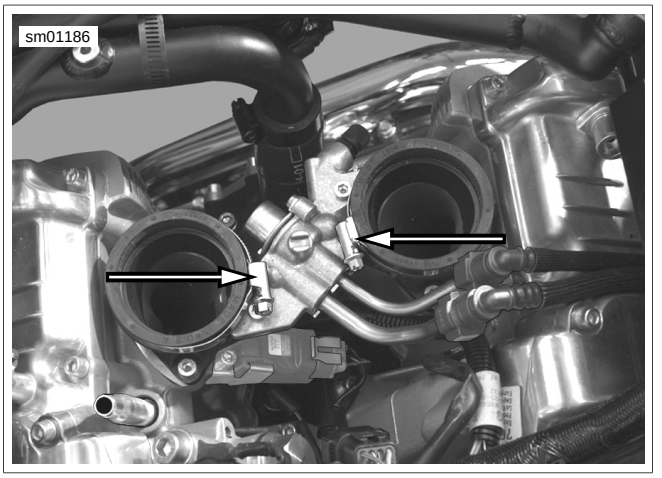
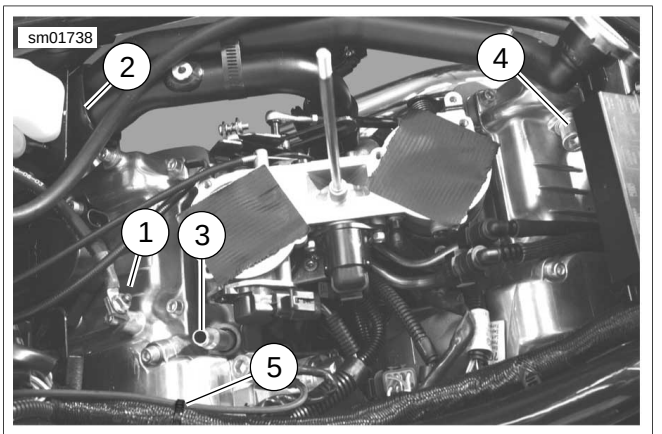



**Figure 1-67. Intake Clamps, Throttle Body Removed (typical)**




1. **Ground strap**
2. **Radiator hose P-clamp**
3. **Front cylinder breather tube**
4. **Rear cylinder breather tube**
5. **Cable strap**

**Figure 1-68. Upper Engine**

10. See Figure 1-67. Loosen clamps at each intake and lift throttle body straight up.

*NOTE*

*Observe the position of the clamps for reassembly.*

11. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine.
12. Cover intake openings to prevent objects from falling into intake bore.
13. See Figure 1-68. Remove ground strap at cam cover.
14. Remove p-clamp (2) retaining radiator hoses.
15. Remove front (3) and rear (4) breather hoses.
16. Remove main harness cable straps (5) along left side of frame.
17. See Figure 1-69. Loosen all cam cover fasteners in reverse order of torque sequence.
18. Support engine with jack under oil pan.
19. See Figure 1-70. Loosen front engine mount bolt and retract jack to allow the engine to drop down approximately 13 mm (1/2 in.).

*NOTE*

*It may be necessary to loosen drive belt, and loosen exhaust at rear support bracket to allow the engine to drop sufficiently.*

20. Remove fasteners from small cam cover and remove from left side.
21. Remove all remaining fasteners from cam cover.
22. Gently pry up cover and gasket. Remove cam cover by lifting up and over cam drive sprockets and removing from right side of motorcycle.

*NOTES*

- *It may be necessary to manipulate or move radiator hoses to allow front cam cover removal.*
- *It may be necessary to remove breather hose fitting from rear cam cover to gain additional clearance.*

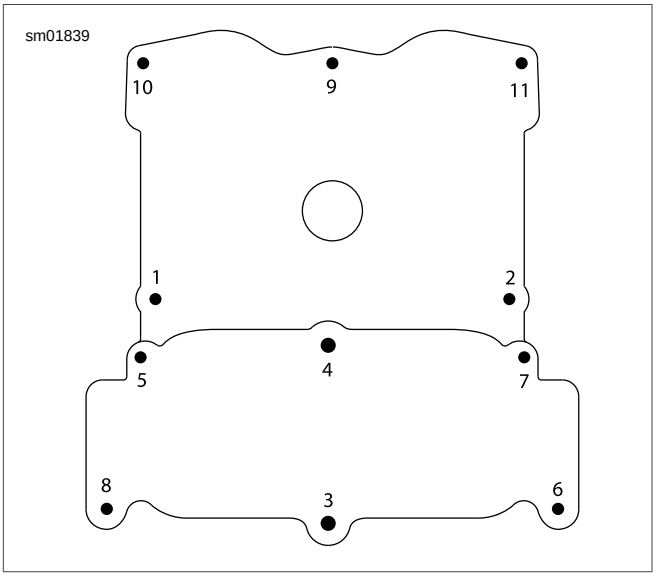



**Figure 1-69. Cam Cover Torque Sequence**

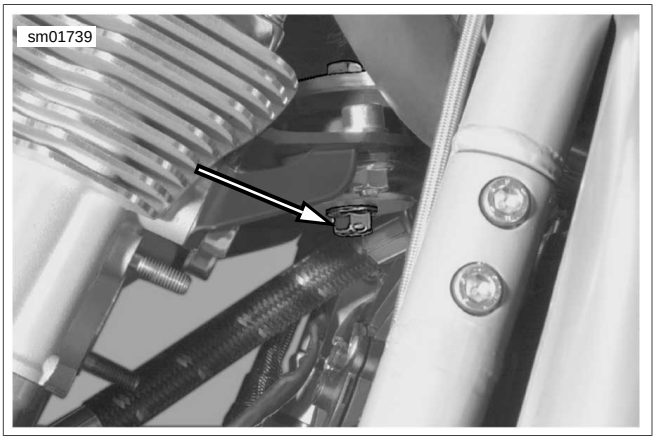



**Figure 1-70. Front Engine Mount Bolt**

23. Remove spark plugs. See 1.22 SPARK PLUGS AND COIL.

*NOTE*

*Spark plugs are only removed to allow the engine to be rotated easily. Spark plugs should be re-installed and torqued immediately after lash is set and before assembly begins.*

24. Remove alternator derby cover to access 36 mm rotor nut.

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

25. Using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) rotate the engine toward front cylinder (direction of operation) until nose of camshaft intake and exhaust are at the 2 o'clock and 10 o'clock position as shown in Figure 1-72.
    a. When adjusting the front cylinder the cam lobes will be at the base circle position on the tappet as shown in Figure 1-72.
    b. When adjusting the rear cylinder the cam lobes will be at the base circle position on the tappet as shown in Figure 1-73.

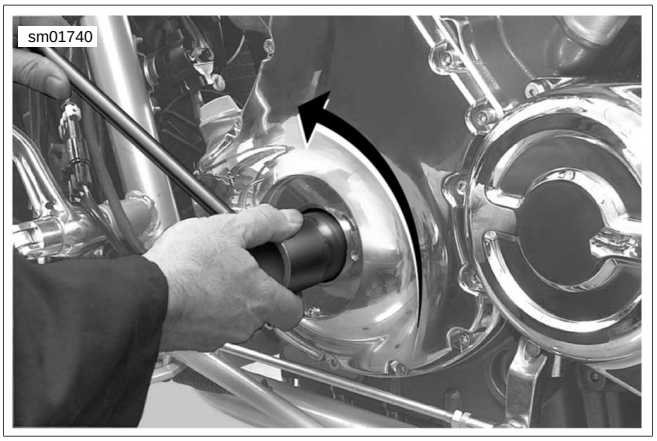



**Figure 1-71. Correct Engine Rotation**

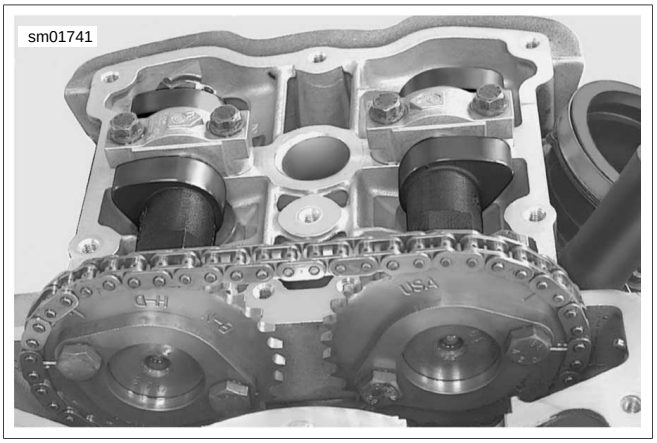



**Figure 1-72. Front Cylinder Cam Lobe Position**

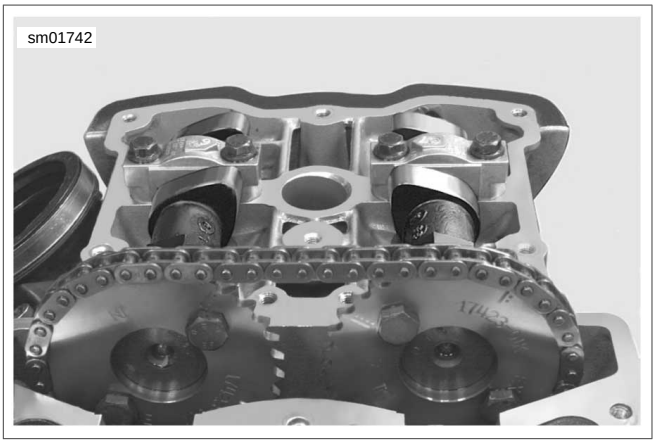



**Figure 1-73. Rear Cylinder Cam Lobe Position**

26. See Figure 1-74. Use blade style metric feeler gauges to measure the gap (lash) between the cam and tappet.

*NOTES*

- *An ANGLE BLADE FEELER GAUGE SET (Part No. HD-47181) is available and may increase the reliability of the readings.*
- *A valve lash calculation worksheet is provided in Appendix D to record the valve lash data. Use this sheet to determine the correct shim selection. Incorrect lash adjustment can cause serious engine damage.*

27. Copy the D.2 VALVE LASH CALCULATION WORKSHEET 1. in Appendix D.

**Table 1-12. Valve Lash Specifications**

| | | MM | IN. |
|---|---|---|---|
| Intake | Max | 0.245 | 0.0096 |
| | Min | 0.195 | 0.0078 |
| Exhaust | Max | 0.345 | 0.0135 |
| | Min | 0.295 | 0.0117 |

28. Gage the lash for exhaust and intake valves and record selected blade thickness in the "Initial Lash Measurement" column of the valve lash calculation worksheet.
29. Repeat valve lash measurements on other cylinder head and record initial lash measurements.
30. Compare measurements to "Valve Lash Upper Limit" column and "Valve Lash Lower Limit" column. A valve requires lash adjustment if:
    a. Measurement is larger than "Valve Lash Upper Limit."
    b. Measurement is smaller than "Valve Lash Lower Limit."

*NOTE*

*If cam caps are removed, install and finger tighten before applying torque.*

31. If all valves are within specification, verify cam timing before reassembly. See 1.25 VALVE LASH, Verify Cam Timing in 1.25 VALVE LASH.
32. If cam timing is correct, install spark plugs, install cam covers and front engine mount according to the instructions

in the following procedure. See 1.25 VALVE LASH, Lash Measurement in 1.25 VALVE LASH.

33. If valve lash must be adjusted, verify cam timing before disassembly. See 1.25 VALVE LASH, Verify Cam Timing in 1.25 VALVE LASH.

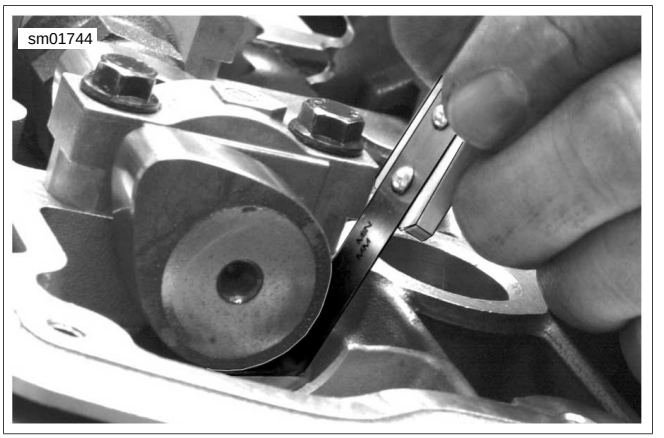



**Figure 1-74. Measuring Valve Lash**

## CAMSHAFT INSPECTION

During the process of adjusting valve lash, be sure to inspect camshafts for wear. The following details different types of cam manufacturing and wear to be considered during inspection VRSC camshafts.

*NOTE*

*It is not necessary to remove camshafts for this inspection. Camshafts are removed for photo-clarity.*

### Lobe Surface Finish

There are two styles of surface finish found on VRSC camshafts. The first is called camground which can be seen in Figure 1-75. This lobe appears very smooth. The second finish is called micro-stoned which can be seen in Figure 1-76. This lobe will have horizontal finish marks on the lobes from the finishing stone used in the manufacturing process. Both are acceptable finishes on VRSC camshaft lobes.




**Figure 1-75. Camground Camshaft Lobes**

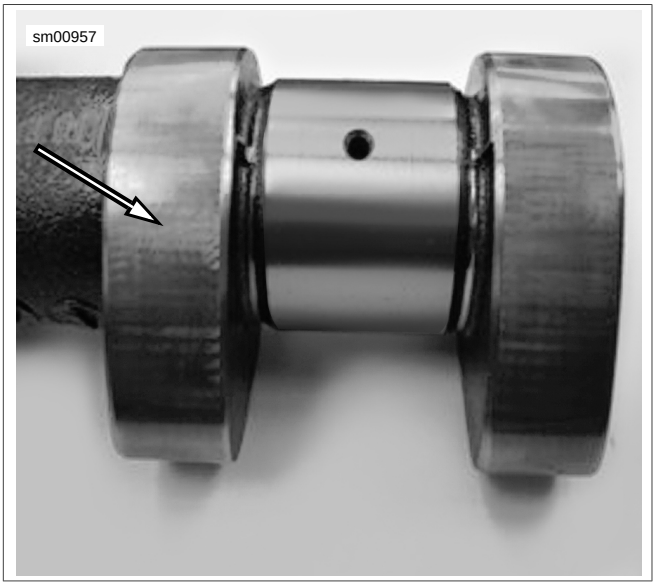



**Figure 1-76. Micro-Stoned Camshaft Lobes**

### Camshaft Spalling (typical)

Camshaft spalling can occur on either the heal, toe or ramp of the camshaft lobe. If within the following guidelines, the spalling is considered within specification.

1. See Figure 1-77. This figure shows camshaft spalling within acceptable specification on the toe of the camshaft lobe.
2. See Figure 1-78. This camshaft shows spalling on the camshaft heel at an unacceptable level as the spalling extends across the entire camshaft lobe.

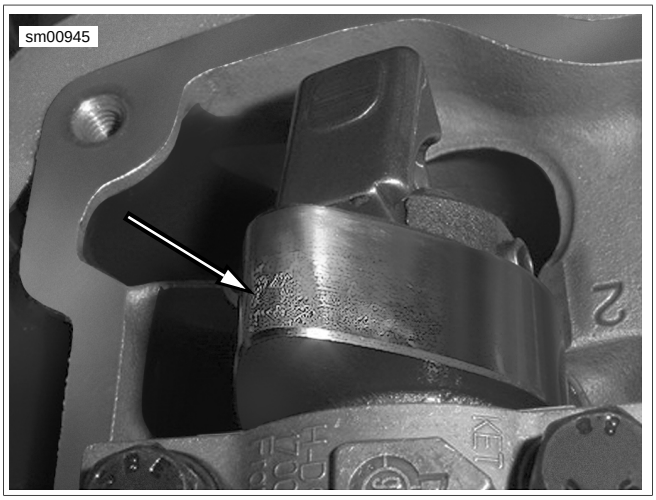



**Figure 1-77. Camshaft Toe Spalling (typical)**

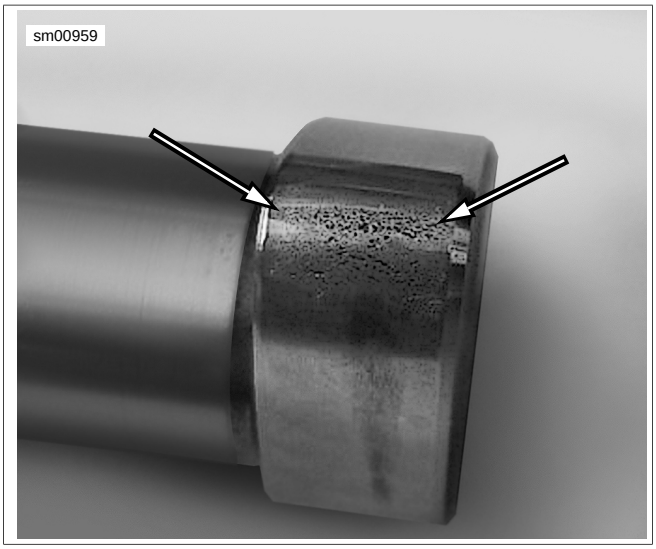



**Figure 1-78. Camshaft Heel Spalling**

*NOTE*

*If camshaft lobe exhibits spalling that extends fully across the width of the camshaft lobe or extends past 15 mm beyond the toe of the camshaft lobe in either direction of camshaft travel, replace camshaft.*

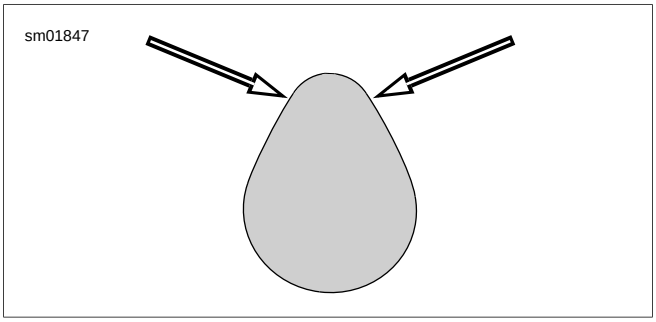



**Figure 1-79. Cam Lobe (typical) showing 15 mm from toe of camshaft lobe on each side of lobe**

## VERIFY CAM TIMING

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45306 | CRANKSHAFT LOCKING PIN |
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45653 | TDC POSITIONING TOOL |

1. See Figure 1-80. Install TDC POSITIONING TOOL (Part No. HD-45653) in front spark plug hole.

*NOTE*

*Never insert a foreign object, such as a screwdriver in the spark plug hole. Engine damage can result.*

2. See Figure 1-81. Remove plug from timing hole.

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

3. Using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) rotate the engine counterclockwise (CCW) (direction of operation) and observe exhaust cam lobe. Note when exhaust valve is closing (TDC Tool will start to extend as valve closes) and engine is approaching TDC.
4. Verify that the TDC POSITIONING TOOL is fully extended and front piston is at TDC.
5. See Figure 1-81. Insert CRANKSHAFT LOCKING PIN (Part No. HD-45306). The CRANKSHAFT LOCKING PIN should insert flush with engine case. If necessary, gently rock crankshaft using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) to lock engine at exact TDC.
6. See Figure 1-82. Note position of cam sprocket gear marks and cam lobe positions. At front cylinder TDC, timing is correct when:
   a. The front exhaust and intake cam gear marks (2, 3) are aligned.
   b. The front exhaust and intake cam lobes (6, 7) are positioned as illustrated.
   c. The rear intake and exhaust cam gear marks (4, 5) are aligned.
   d. The rear intake and exhaust cam lobes (8, 9) are positioned as illustrated.

*NOTE*

*Copper colored links (1) are only used in installation of cam chains. They may not appear in the positions illustrated.*

7. If cam timing is incorrect, see 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING.
8. If cam timing is correct, Remove CRANKSHAFT LOCKING PIN.
9. Install engine timing plug in timing hole. Tighten to 23 Nm (17 ft-lbs).

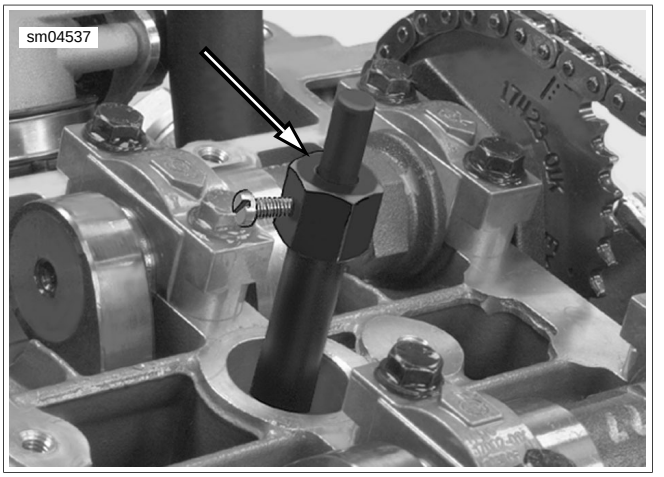



**Figure 1-80. Top Dead Center Positioning Tool**

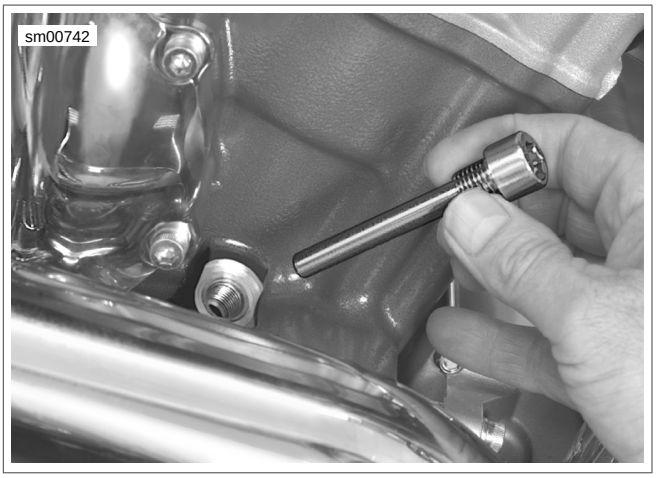
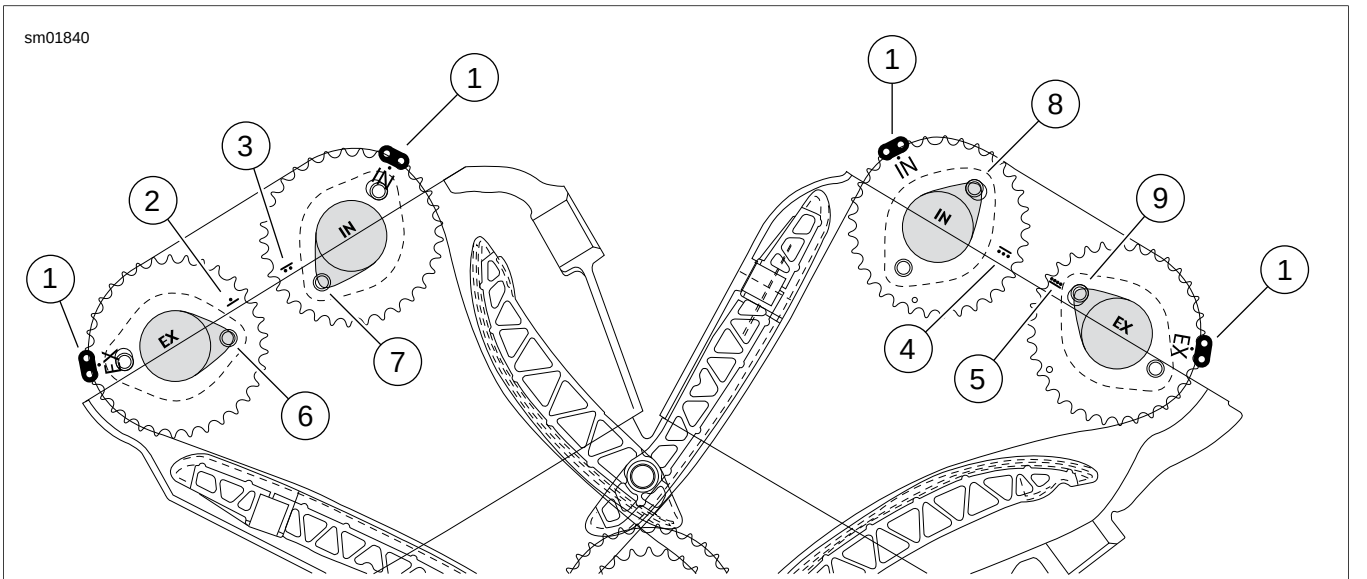



**Figure 1-81. Crankshaft Locking Pin (HD-45306)**




1. **Copper links (may not appear where illustrated)**
2. **Front exhaust alignment mark (single dot and line)**
3. **Front intake alignment mark (two dots and line)**
4. **Rear intake alignment mark (three dots and line)**
5. **Rear exhaust alignment mark (four dots and line)**
6. **Front exhaust cam lobe position**
7. **Front intake cam lobe position**
8. **Rear intake cam lobe position**
9. **Rear exhaust cam lobe position**

**Figure 1-82. TDC Cam Timing Orientation**

*NOTE*

*See Figure 1-82. Even though the timing is correct, the copper links may not appear in the positions illustrated. The copper links are used only in the installation of cam chains.*

## LASH ADJUSTMENT

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45340 | GASKET ALIGNMENT TOOL |

1. See Figure 1-83. Using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) rotate the crankshaft toward front cylinder (direction of operation) to position front cylinder cam lobes at 10 o'clock and 2 o'clock.

2. See Figure 1-84. Clean oil from cam drive gear and chain link. Make a reference mark on chain and cam drive gear, both intake and exhaust, as shown.

*NOTE*

*Copper colored links are for initial assembly of complete cam drive system.*

3. See Figure 1-85. Remove secondary cam chain tensioner.

*NOTES*

- *NEVER rotate engine with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.*
- *Do not remove cam drive gear bolts. It is not necessary for the lash adjustment.*

*NOTE*

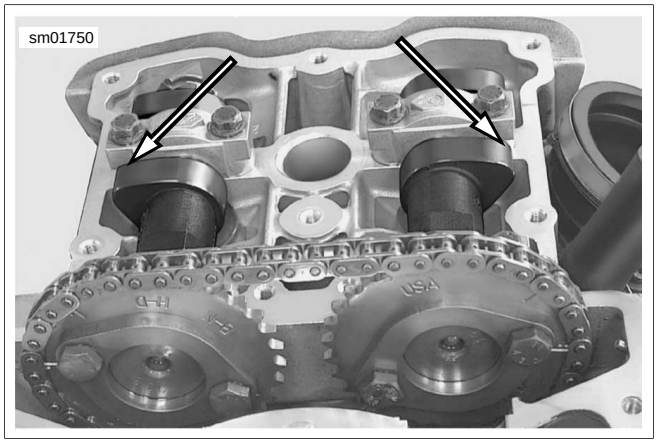



**Figure 1-83. Front Cylinder 10 and 2 O'clock Cam Lobe Position**

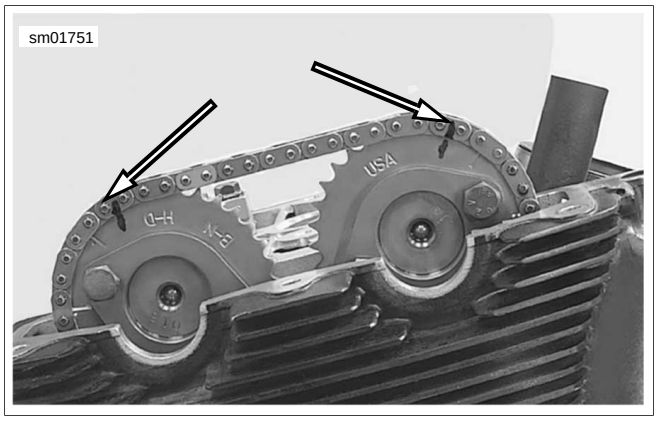



**Figure 1-84. Reference Mark Cam Gear and Chain Link**

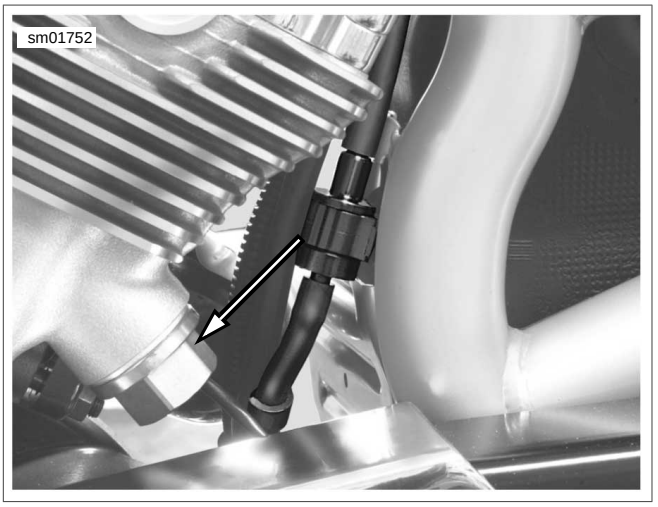



**Figure 1-85. Secondary Cam Chain Tensioner**

4. See Figure 1-86. Remove cam journal fasteners and caps from the cam needing adjustment.

*NOTE*

*Remove and adjust only one camshaft at a time.*

5. See Figure 1-87. Carefully move cam and drive gear aside. Keep cam drive gear and chain engaged.

*NOTE*

*Handle chain and cam assembly carefully so as not to remove reference marks.*

6. Carefully remove tappet. Oil film will usually cause shim to adhere to the under side of the tappet. Take care that shim does not dislodge and fall into engine. To remove tappet, use of a strong magnet is suggested. This will keep shim and tappet together during removal.

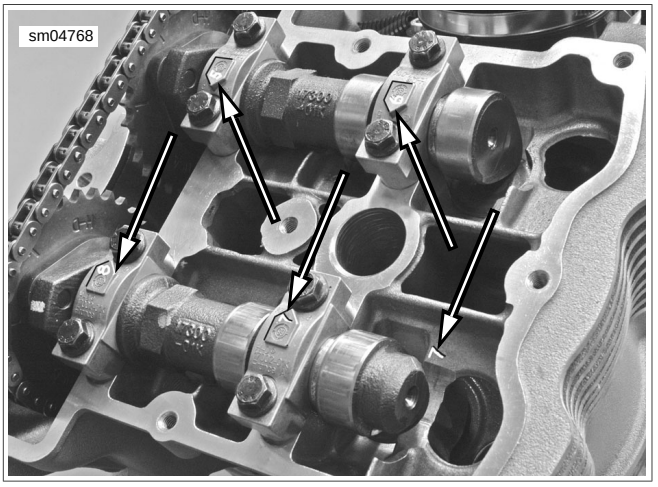



**Figure 1-86. Cam Journal Caps**

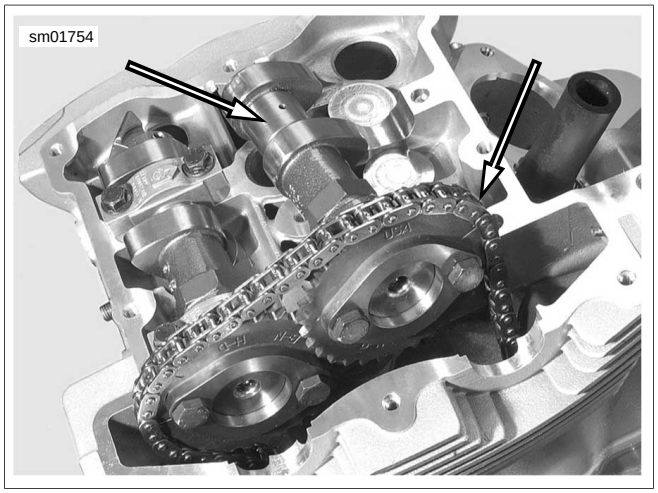



**Figure 1-87. Move Cam Aside With Chain Engaged**

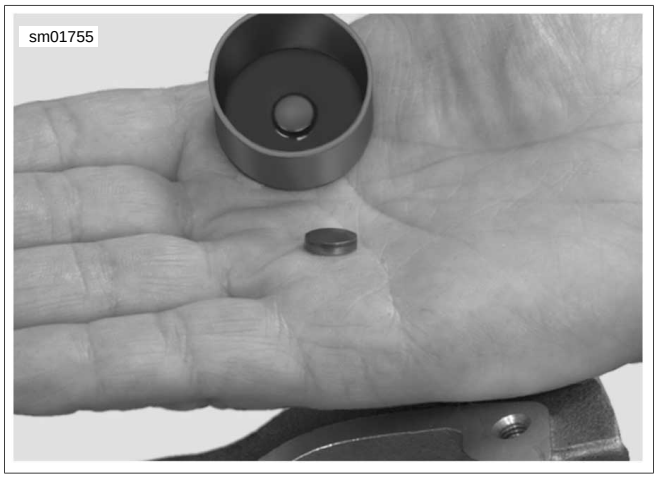
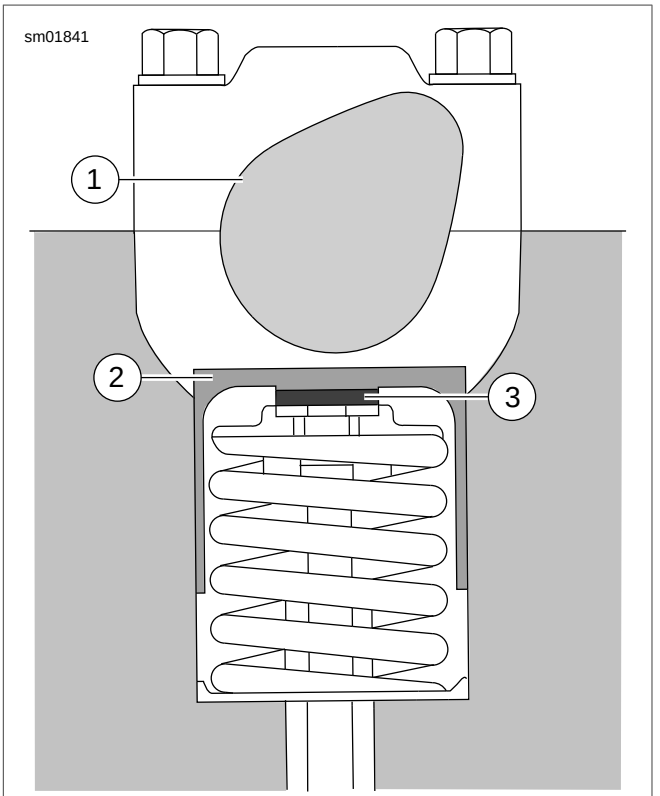



**Figure 1-88. Tappet And Shim**




1. **Cam shaft**
2. **Tappet**
3. **Shim**

**Figure 1-89. Cam, Tappet, Shim Orientation**

7. Use a micrometer to measure the thickness of the removed shim. Record measurement in the "Installed Shim Measurement" column on valve lash calculation worksheet. See D.3 VALVE LASH CALCULATION WORKSHEET 2.

*NOTE*

*Only use genuine Harley-Davidson shims for adjusting valve lash. Do not use typical shim stock. Shim stock can dislodge and cause severe engine damage.*

8. Calculate and record on the valve lash calculation worksheet the "New Shim Lower Limit" and the "New Shim Upper Limit."
9. Calculate and record "Desired Shim Size."
10. Select and record the "Closest Shim Size" replacement shim. Refer to Table D-1. Case 1 Valve Tappet Shims and Table D-2. Case 2 Valve Tappet Shims.
11. Always confirm **new** shim thickness with micrometer. Record for reference.
12. See Figure 1-91. Position **new** shim in spring retainer pocket. Use a magnet to position the shim and carefully push into place with finger.
13. Reinstall tappet.
14. If the initial lash measurement of the remaining valve exceeds the upper or lower valve lash limits, perform the lash adjustment on the remaining valve.

15. See Figure 1-84. Install cam in alignment with **new** reference marks on drive chain and cam drive gear. Note **new** reference marks from step 2.
16. See Figure 1-92. Cam journal caps are numbered. Install cam journal caps with corresponding number on head, arrow pointing to center of head. Lubricate cam journal and journal cap with oil before placing in position.
17. Tighten cam bearing caps to 9.7 Nm (86 **in-lbs**).
18. Review the valve lash calculation worksheet and make adjustments to the valves activated by the opposite cam if necessary.

*NOTE*

*NEVER rotate engine with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.*

19. When second cam has been set aside, the valve lash adjusted, and the cam reinstalled, install secondary cam chain tensioner.




**Figure 1-90. Measure Shim**

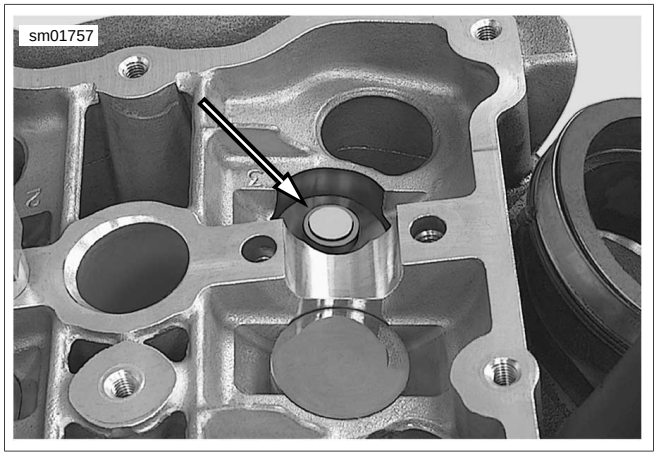



**Figure 1-91. Position Shim**

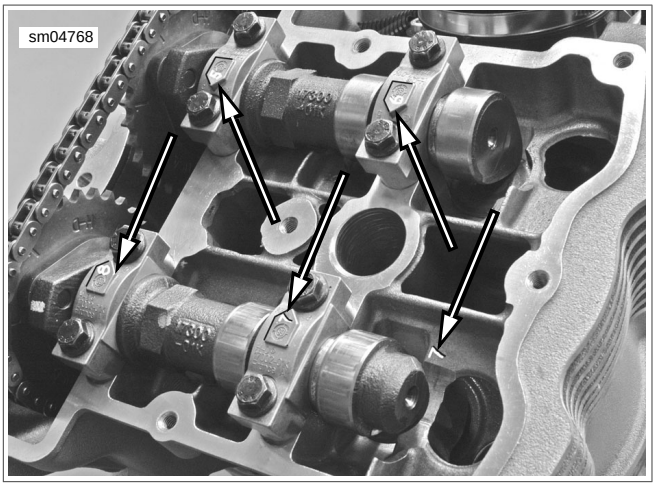


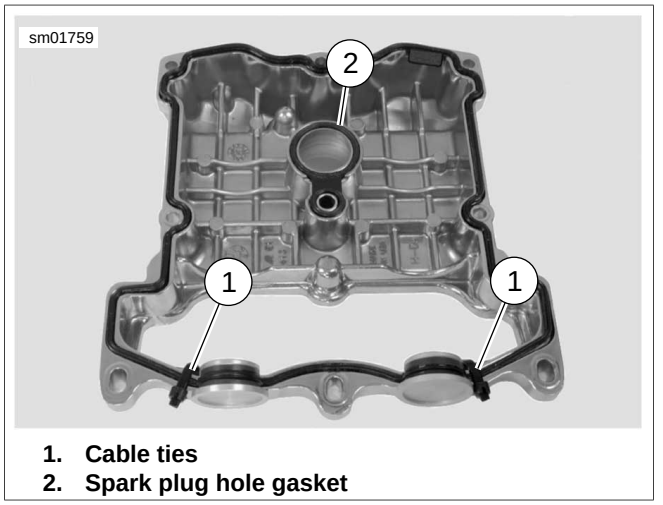

**Figure 1-92. Cam Journal Caps**

20. Rotate engine two complete revolutions (counter-clockwise, direction of rotation) until cam lobes return to 10 o'clock and 2 o'clock position.
21. Re-measure valve lash of all front cylinder cams and record "Final Lash Reading" on the worksheet.
22. Review the worksheet for the rear cylinder valves and make adjustments as needed.
23. See Figure 1-73. Turn engine over to position rear cylinder cams at the 2 o'clock and 10 o'clock position and repeat the procedures for the rear cylinder.
24. After lash adjustment is complete, verify cam timing on both cylinders. See 1.25 VALVE LASH, Verify Cam Timing in 1.25 VALVE LASH.
25. When lash adjustment is verified install and tighten spark plugs to 23 Nm (17 ft-lbs).
26. Clean cam cover and install **new** gasket.
27. See Figure 1-93. Use cable ties (1) to help retain gasket as shown.
28. See Figure 1-95. Insert GASKET ALIGNMENT TOOL (Part No. HD-45340) into small hole in cylinder head next to spark plug hole.
29. Carefully install cam cover and gasket. Cable ties will allow the cam bore plug to be moved horizontally to clear cam drive gears.
30. Visually check to ensure spark plug hole gasket (2) is in place.

*NOTE*

*See Figure 1-94. The seal of the spark plug hole gasket is correct when the tapered edge of the gasket is in the cam cover and the double lipped side of the rings is facing out to mate with the flat of the cylinder head.*

31. Remove cable ties.
32. Place small cam cover in position on large cam cover.




1. **Cable ties**
2. **Spark plug hole gasket**

**Figure 1-93. Cam Cover Gaskets**




**Figure 1-94. Spark Plug Hole Gasket (double lipped side)**

33. See Figure 1-96. Insert fasteners in cam cover and tighten to 9.7 Nm (86 **in-lbs**) in sequence.
34. See Figure 1-70. Tighten front engine mount fastener to 38 Nm (28 ft-lbs).
35. Position the main harness along the left side of the frame and install cable straps.
36. Install front cylinder and rear cylinder breather hoses.
37. Install p-clamp around the right side radiator hoses and tighten fastener to 9.7 Nm (86 **in-lbs**).
38. Connect ground strap to cam cover. Tighten to 9.7 Nm (86 **in-lbs**).
39. See Figure 1-97. Orient intake clamps as shown.
40. Install throttle body and tighten clamps.
41. See 1.22 SPARK PLUGS AND COIL. Install coils.
42. Attach the idle speed control (IAC) connector.
43. Attach the throttle position (TP) sensor.
44. Attach fuel lines.
    a. Insert fuel lines from injector back under frame and connect to fuel tank.
    b. Push connector onto fuel tank elbow until a "click" is heard.
    c. Install right angle connectors on rigid lines from injector. Push until a "click" is heard.
45. Install battery. See 1.9 BATTERY MAINTENANCE.
46. Install airbox assembly. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

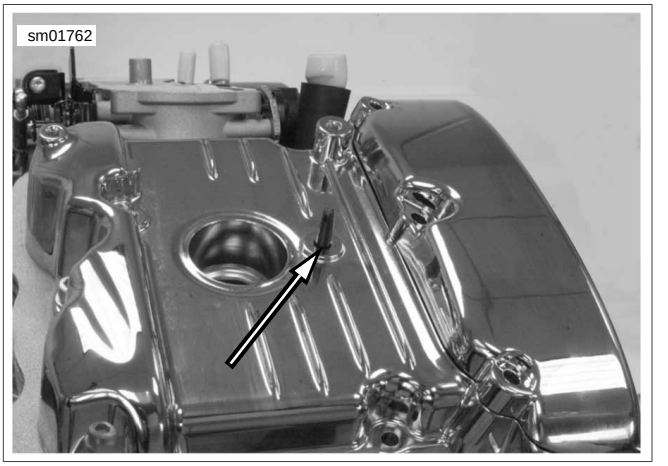



**Figure 1-95. Gasket Alignment Tool (H-D-45340)**

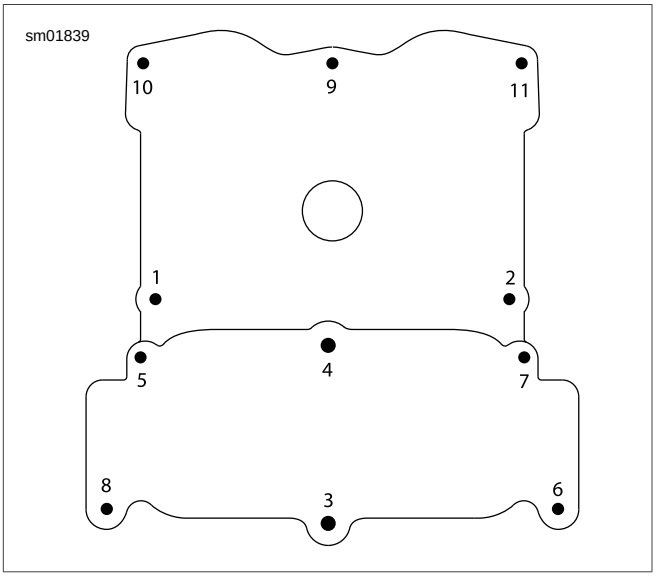



**Figure 1-96. Cam Cover Torque Sequence**

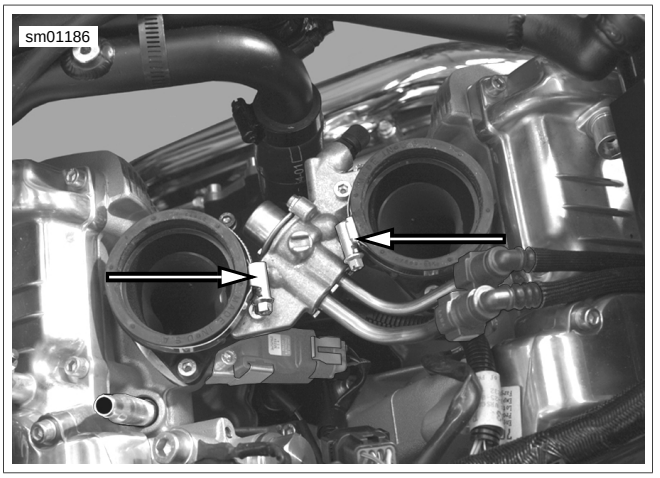



**Figure 1-97. Intake Clamps, Throttle Body Removed (typical)**

## GENERAL

On high mileage engines with good oil pressure, if there is a noise at start-up which goes away, check secondary cam chain wear. Before beginning procedure, note if the rattle is heard during engine start-up.

## ADJUSTMENT

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45334 | SECONDARY CAM CHAIN MEASUREMENT TOOL |
| HD-45334 | SECONDARY CAM CHAIN MEASUREMENT TOOL |

1. Support engine with a scissors jack under the frame at the fuel tank.
2. Remove the right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat.
4. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

5. Disconnect negative battery cable.
6. Remove air filter top and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
7. Remove the horn. See 8.21 HORN.
8. Remove the derby cover from the left side crankcase cover.

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

9. To position the front piston to adjust the secondary cam chain:
   a. See Figure 1-98. Install CRANKSHAFT ROTATING WRENCH (Part No. HD-45314).
   b. Hold the throttle wide open and watch front cylinder intake valve through intake port.
   c. Turn crankshaft counterclockwise to open valve fully and then to close the valve.
   d. When the front cylinder intake valve is seated, turn crankshaft an additional 1/4 turn (90°) counterclockwise.

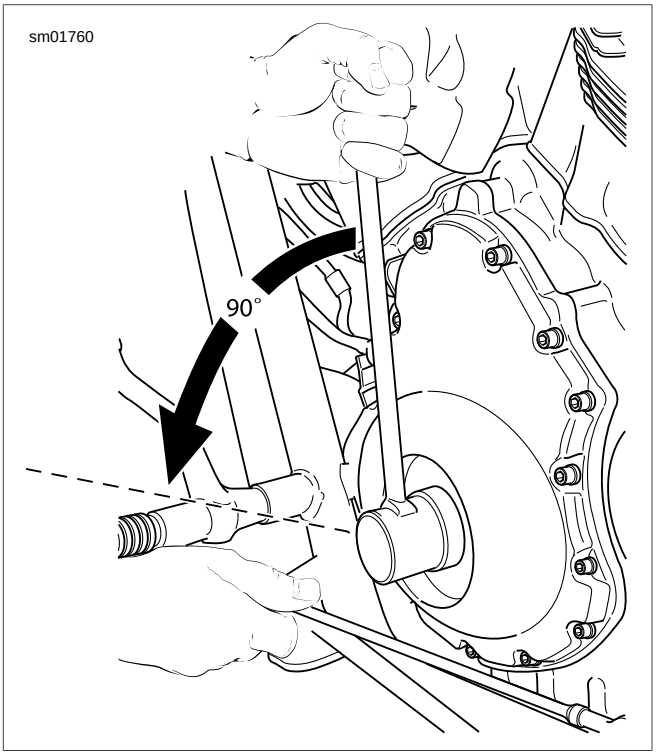



**Figure 1-98. Positioning Piston**

*NOTE*

*Never rotate the engine without the secondary cam chain tensioner installed. Cam timing could be changed, causing engine damage.*

*NOTE*

*Do not use the sealing washer from the secondary cam chain tensioner when installing the SECONDARY CAM CHAIN MEASUREMENT TOOL (Part No. HD-45334).*

10. Remove the secondary cam chain tensioner.
11. See Figure 1-99. install SECONDARY CAM CHAIN MEASUREMENT TOOL. Thread-in the tool until it is seated against the cylinder head.
12. Note the number of grooves showing on the tool.
13. Remove the SECONDARY CAM CHAIN MEASUREMENT TOOL.
14. From the table, select the number of shims necessary for correct secondary cam chain tension. Refer to Table 1-13.

*NOTE*

*If a start-up rattle is present, add 1 or 2 shims to the tensioner. If there is no start-up rattle, do not add shims to the tensioner.*

**Table 1-13. Tensioner Shims**

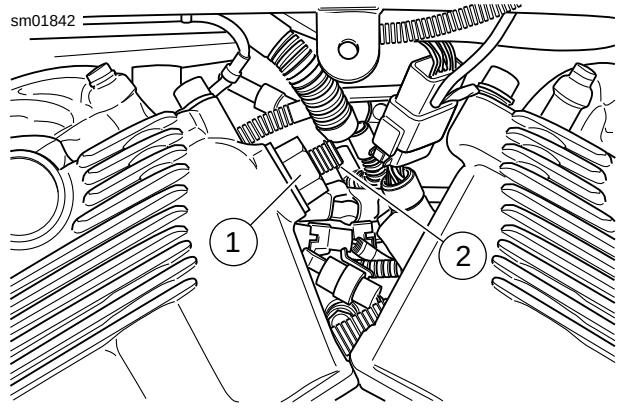
| GROOVES | SHIMS REQUIRED |
|---|---|
| 4 | 1* |
| 3 | 2* |
| 2 | 3 |
| 1 | 4 |
| *Do not add shims if start-up rattle is not heard. | |

15. See Figure 1-100. Wrap cardboard or heavy cloth around thick shaft on plunger (1). Gently twist while pulling to remove plunger (1) from tensioner (3).
16. Apply a thin film of Harley-Davidson Motorcycle Oil 20W50 to selected shims (2) and plunger (1).
17. Seat number of selected shims (2) and plunger (1) in tensioner (3).
18. Lubricate tensioner seal (4) with Harley-Davidson Motorcycle Oil 20W50.
19. Install front cylinder secondary cam chain tensioner. Tighten to 100 Nm (74 ft-lbs).

**CAUTION**

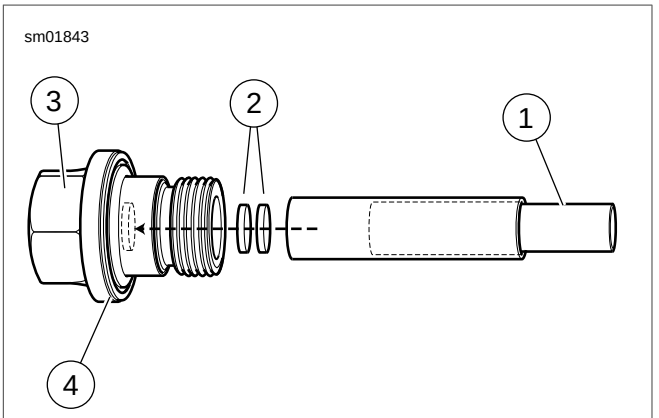
**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

20. To position rear cylinder to adjust secondary cam chain:
    a. See Figure 1-98. Install CRANKSHAFT ROTATING WRENCH (Part No. HD-45314).
    b. Hold throttle wide open and watch rear cylinder intake valve through intake port.
    c. Turn crankshaft counterclockwise to open valve fully and then close intake valve.




1. **Secondary cam chain measurement tool**
2. **Visible grooves**

**Figure 1-99. Secondary Cam Chain Measurement Tool Installed in Front Cylinder**




1. **Plunger**
2. **Shims (as required)**
3. **Secondary cam chain tensioner**
4. **Seal**

**Figure 1-100. Secondary Cam Chain Tensioner**

21. When rear cylinder intake valve is seated, turn crankshaft an additional 1/4 turn (90°) counterclockwise (CCW).

*NOTE*

*Do not use the sealing washer from the secondary cam chain tensioner when installing the SECONDARY CAM CHAIN MEASUREMENT TOOL (Part No. HD-45334).*

22. See Figure 1-99. Remove rear cylinder secondary cam chain tensioner and install SECONDARY CAM CHAIN MEASUREMENT TOOL. Thread-in the tool until it is seated against cylinder head.
23. Note the number of grooves showing on tool.
24. Remove SECONDARY CAM CHAIN MEASUREMENT TOOL.
25. Refer to Table 1-13. From the table, select the number of shims necessary for correct secondary cam chain tension.

*NOTE*

*If a start-up rattle was noticed, 1 or 2 shims are added to the tensioner. If there was no start-up rattle, do not add 1 or 2 shims to the tensioner.*

26. See Figure 1-100. Wrap cardboard or heavy cloth around thick shaft on plunger (1). Gently twist while pulling to remove plunger (1) from tensioner (3).
27. Apply a thin film of Harley-Davidson Motorcycle Oil 20W50 to selected shims (2) and plunger (1).
28. Seat number of selected shims (2) and plunger (1) in tensioner (3).
29. Lubricate tensioner seal (4) with Harley-Davidson Motorcycle Oil 20W50.
30. Install rear cylinder secondary cam chain tensioner. Tighten to 100 Nm (74 ft-lbs).
31. Install the horn. See 8.21 HORN.
32. Connect negative battery cable.
33. Install air filter and air filter top. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
34. Install airbox cover.

35. Install the right side cover and maxi-fuse.

36. Turn ignition switch to FUEL and close seat. Then turn ignition switch to LOCK.

## INSPECTION

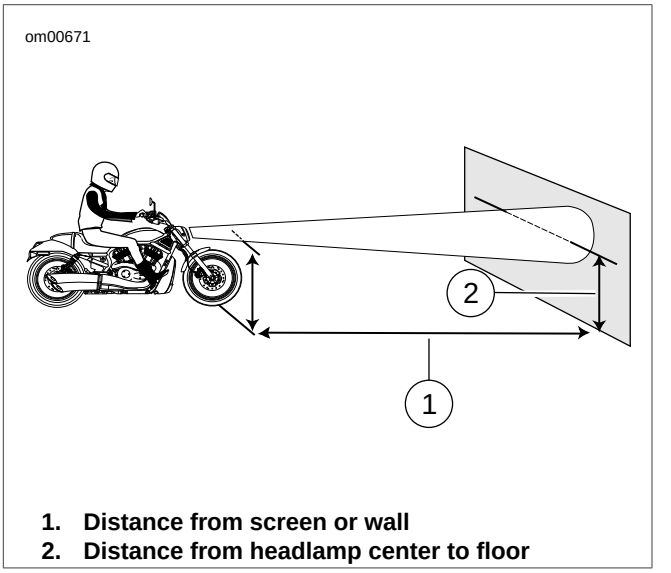
**⚠WARNING**

**The automatic-on headlamp feature provides increased visibility of the rider to other motorists. Be sure headlamp is on at all times. Poor visibility of rider to other motorists can result in death or serious injury. (00030b)**

Check headlamp for proper height and lateral alignment:

- When the new owner takes delivery of the motorcycle.
- When there is a change in load (adding luggage, etc.).

1. Verify correct front and rear tire pressure. See 1.13 TIRES AND WHEELS.
2. Place motorcycle on level floor (or pavement) in an area with minimum light.
3. See Figure 1-101. Position motorcycle 7.6 m (25 ft) away from a screen or wall (1). Measure the vertical distance from center of headlamp to floor (2), and draw a horizontal line on screen or wall at same height above floor.
4. Load vehicle with rider, passenger (if normally present) and any cargo. Weight will compress vehicle suspension slightly.
5. Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
6. See Figure 1-102. Turn ignition switch ON. Set handlebar headlamp switch to HI beam position.
7. Check light beam for alignment.
   a. The main beam, which is a broad, flat pattern of light, should be centered equally above and below the horizontal line.
   b. The main beam of light should also be directed straight ahead. Properly adjusted headlamps project an equal area of light to right and left of center.
   c. Adjust headlamp alignment if necessary.




**1. Distance from screen or wall**
**2. Distance from headlamp center to floor**

**Figure 1-101. Headlamp Alignment**

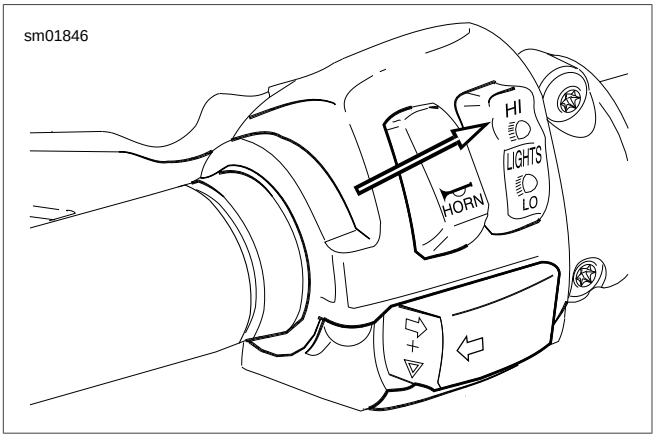



**Figure 1-102. Headlamp Switch**

## ADJUSTMENT

1. See Figure 1-103. Loosen fasteners slightly so headlamp is still snug.
2. Adjust accordingly and tighten fasteners to 34-41 Nm (25-30 ft-lbs).




**Figure 1-103. Headlamp Alignment Fastener (VRSCAW models)**

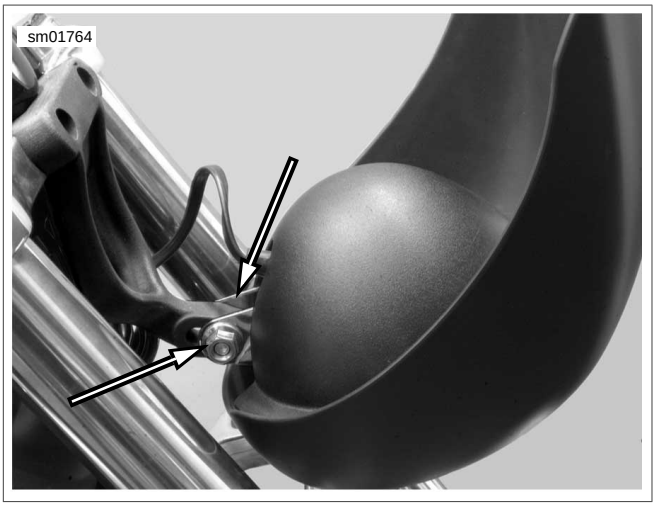



**Figure 1-104. Headlamp Alignment Fastener (VRSCD, VRSCDX)**

## INSPECTION

Refer to Table 1-14. Tighten all critical fasteners, except head bolts, to service manual specifications. Replace any damaged or missing hardware.

**Table 1-14. Critical Fasteners**

| SYSTEM | FASTENER | TORQUE | |
|---|---|---|---|
| Hand controls | Upper and lower switch housings | 4.0-5.1 Nm | 35-45 **in-lbs** |
| | Clutch lever handlebar clamp | 8.0-9.0 Nm | 70-80 **in-lbs** |
| | Master cylinder handlebar clamp | 8.0-9.0 Nm | 70-80 **in-lbs** |
| Brakes | Banjo bolts | 23-29 Nm | 17-22 ft-lbs |
| | Lower brake caliper mounting pin | 38.0-51.5 Nm | 28-38 ft-lbs |
| | Brake disc screws, front | 23-31 Nm | 17-23 ft-lbs |
| | Brake disc screws, rear | 41-53 Nm | 30-39 ft-lbs |
| | Reservoir screws | 0.8-1.2 Nm | 7-11 **in-lbs** |
| Axle nuts | Front axle | 67.8-75 Nm | 50-55 ft-lbs |
| | Rear axle | 190-203 Nm | 140-150 ft-lbs |
| Front fork/handlebars | Lower fork pinch bolts | 44 Nm | 32 ft-lbs |
| | Upper bracket pinch bolts | 44 Nm | 32 ft-lbs |
| Rear shock absorbers | Lower shock absorber bolts | 41-68 Nm | 31-50 ft-lbs |
| | Upper shock absorber bolts | 41-68 Nm | 31-50 ft-lbs |

## GENERAL

If the motorcycle will not be operated for several months, such as during the winter season, there are several things which should be done to protect parts against corrosion, to preserve the battery and to prevent the buildup of gum and varnish in the fuel system.

This work should be performed by your local Harley-Davidson dealer or other qualified technician following Service Manual procedures.

## PLACING IN STORAGE

| PART NUMBER | TOOL NAME |
|---|---|
| 98716-87A | STORAGE COVER |

**WARNING**

**Do not store motorcycle with gasoline in tank within the home or garage where open flames, pilot lights, sparks or electric motors are present. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00003a)**

1. Run motorcycle until engine is at normal operating temperature. Stop the engine then drain the oil pan, install a **new** oil filter, and fill oil pan with the proper grade oil. Check the transmission lubricant level.

**WARNING**

**Avoid spills. Slowly remove filler cap. Do not fill above bottom of filler neck insert, leaving air space for fuel expansion. Secure filler cap after refueling. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00028a)**

**WARNING**

**Use care when refueling. Pressurized air in fuel tank can force gasoline to escape through filler tube. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00029a)**

2. Prepare your fuel system by filling fuel tank and adding a gasoline stabilizer. Use one of the commercially available gasoline stabilizers following the manufacturer's instructions.
3. Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Reinstall spark plugs.
4. Inspect rear belt deflection. See 1.16 REAR BELT DEFLECTION.
5. Inspect rear belt and sprockets. See 1.17 REAR BELT AND SPROCKETS.
6. Inspect air cleaner filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
7. Lubricate controls. See 1.23 CABLE, LINE AND FRAME INSPECTION.
8. Inspect operation of all electrical equipment and switches.
9. Check tire inflation and inspect tires for wear and/or damage. See 1.13 TIRES AND WHEELS. If the motorcycle will be stored for an extended period of time, securely support the motorcycle under the frame so that all weight is off the tires.

**WARNING**

**Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)**

10. Wash painted and chrome-plated surfaces. Apply a light film of oil to exposed unpainted surfaces.

**WARNING**

**Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a)**

**WARNING**

**Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. KEEP BATTERIES AWAY FROM CHILDREN. (00065a)**

11. Remove battery from vehicle. Charge battery until the correct voltage is obtained. Charge the battery every other month if it is stored at temperatures below 16° C (60° F). Charge battery once a month if it is stored at temperatures above 16° C (60° F). See 1.9 BATTERY MAINTENANCE.

**WARNING**

**Unplug or turn OFF battery charger before disconnecting charger cables from battery. Disconnecting clamps with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00067a)**

12. If the motorcycle is to be covered, use a material that will breathe, such as STORAGE COVER (Part No. 98716-87A) or light canvas. Plastic materials that do not breathe promote the formation of condensation, which leads to corrosion.

## REMOVAL FROM STORAGE

**WARNING**

**The clutch failing to disengage can cause loss of control, which could result in death or serious injury. Prior to starting after extended periods of storage, place transmission in gear and push vehicle back and forth several times to assure proper clutch disengagement. (00075a)**

1. Charge and install the battery.

2. Remove and inspect the spark plugs. Replace if necessary.
3. Clean the air cleaner element.
4. If fuel tank was drained, fill fuel tank with fresh gasoline.
5. Start the engine and run until it reaches normal operating temperature.
6. Check engine oil level. Check the transmission lubricant level. Fill to proper levels with correct fluids, if required.
7. Perform all of the checks in the PRE-RIDING CHECKLIST in the Owner's Manual.

## GENERAL

**⚠WARNING**

**The Troubleshooting section of this manual is a guide to diagnose problems. Read the appropriate sections of this manual before performing any work. Improper repair and/or maintenance could result in death or serious injury. (00528b)**

The following check list of possible operating troubles and their probable causes will be helpful in keeping a motorcycle in good operating condition. More than one of these conditions may be causing the trouble and all should be carefully checked.

*NOTES*

- *For further troubleshooting information, see the Electrical Diagnostics Manual.*
- *For troubleshooting the cooling system, review the check list of operating troubles in 6.2 COOLANT FLOW*

## ENGINE

### Starter Motor Does Not Operate or Does Not Turn Engine Over

1. Ignition switch not in ON position.
2. Engine run switch in OFF position.
3. Maxi-fuse not in place.
4. Discharged battery, loose or corroded connections (solenoid chatters).
5. Starter control circuit, relay, or solenoid faulty.
6. Electric starter shaft pinion gear not engaging or overrunning clutch slipping.
7. Crankshaft locking pin is in place.
8. TSM/TSSM/HFSM Bank Angle Sensor tripped and ignition switch not cycled OFF then ON.

### Engine Turns Over But Does Not Start

1. Fuel tank empty.
2. Fuel filter clogged.
3. Fouled spark plugs.
4. Sticking or damaged valve.
5. Discharged battery, loose or broken battery terminal connections.
6. Engine lubricant too heavy (winter operation).

*NOTE*

*For cold weather starts, always disengage clutch.*

7. Loose wire connection at coil(s), battery or ECM connector.
8. Ignition timing incorrect due to faulty coil(s), ECM or sensors (MAP, CKP and/or TSM/TSSM/HFSM).
9. Bank Angle Sensor tripped and ignition switch not cycled OFF then ON.

### Starts Hard

1. Spark plugs in bad condition or have improper gap or are partially fouled.
2. Battery nearly discharged.
3. Loose wire connection at one of the battery terminals, coil(s) or ECM connector.
4. Water or dirt in fuel system.
5. Intake air leak.
6. Fuel tank vent hose and vapor valve plugged, or fuel line closed off, restricting fuel flow.
7. Engine lubricant too heavy (winter operation).

*NOTE*

*For cold weather starts, always disengage clutch.*

8. Ignition not functioning properly (possible sensor failure).
9. Faulty ignition coil(s).
10. Valves sticking or valves too tight.
11. Rotor key sheared.

### Starts But Runs Irregularly or Misses

1. Spark plugs in bad condition or partially fouled.
2. Spark plug gap too close or too wide.
3. Faulty ignition coil(s), ECM, or sensor.
4. Battery nearly discharged.
5. Damaged wire or loose connection at battery terminals, coil(s) or ECM connector.
6. Intermittent short circuit due to damaged wire insulation.
7. Water or dirt in fuel system.
8. Fuel tank vent system plugged.
9. Air leak at intake manifold or air filter.
10. Loose or dirty ECM connector.
11. Faulty Sensor(s): Manifold Absolute Pressure (MAP) or Crank Position (CKP).
12. Incorrect valve timing.
13. Weak or broken valve springs.
14. Damaged intake or exhaust valve.

### Spark Plug Fouls Repeatedly

1. Fuel mixture too rich.
2. Incorrect spark plug for the kind of service.
3. Piston rings badly worn or broken.
4. Valve guides or seals badly worn.

### Pre-Ignition or Detonation (Knocks or Pings)

1. Fuel octane rating too low.
2. Faulty spark plugs.

3. Incorrect spark plug for the kind of service.
4. Excessive carbon deposit on piston head or in combustion chamber.
5. Ignition timing advanced due to faulty sensors (MAP and/or CKP).
6. Air leak.

### Overheating

1. Insufficient oil supply or oil not circulating.
2. Insufficient air flow over engine.
3. Heavy carbon deposit.
4. Ignition timing retarded due to faulty sensor(s): Manifold Absolute Pressure (MAP) and/or Crank Position (CKP).
5. Leaking valve.
6. Radiator dirty, plugged.
7. Insufficient coolant supply.
8. Vent hose crimped.
9. Air in cooling system.

### Valve Train Noise

1. Low oil pressure caused by oil feed pump not functioning properly or oil passages obstructed.
2. Valve sticking in guide.
3. Chain tensioning spring or shoe worn.
4. Cam timing incorrect.
5. Secondary cam tensioner out of range.

### Excessive Vibration

1. Wheels and/or tires worn or damaged.
2. Engine/transmission/rear wheel not aligned properly.
3. Upper engine mounting bracket loose/broken or mounting bracket pre-loaded.
4. Ignition timing advanced due to faulty sensor inputs (MAP and/or CKP)/poorly tuned engine.
5. Internal engine problem.
6. Broken frame.
7. Engine counterbalancer out of time or bearing failed.
8. Exhaust system binding or hitting frame.

### Check Engine Light Illuminates During Operation

Fault detected. See the Electrical Diagnostic Manual.

## LUBRICATION SYSTEM

### Engine Uses Too Much Oil Or Smokes Excessively

1. Restricted breather operation.
2. Restricted oil filter.
3. Piston rings badly worn or broken.
4. Valve guides or seals worn.
5. Oil diluted with gas.

### Engine Leaks Oil From Cases, Hoses, Etc.

1. Loose parts.
2. Imperfect seal at gaskets, washers, etc.
3. Restricted breather hose to air filter.
4. Restricted oil filter.
5. Porosity.

### Low Oil Pressure

1. Oil sump underfilled.
2. Faulty low oil pressure switch.
3. Oil pump O-ring damaged or missing.
4. Bypass valve stuck in open position.
5. Oil diluted with gas.
6. Open in oiling circuit.

### High Oil Pressure

1. Oil sump overfilled.
2. Bypass valve stuck in closed position.

## ELECTRICAL SYSTEM

*NOTE*

*For diagnostic information see the ELECTRICAL DIAGNOSTIC MANUAL.*

### Alternator Does Not Charge

1. Voltage regulator module not grounded.
2. Engine ground wire loose or broken.
3. Faulty voltage regulator module.
4. Loose or broken wires in charging circuit.
5. Faulty stator and/or rotor.

### Alternator Charge Rate Is Below Normal

1. Weak or damaged battery.
2. Loose connections.
3. Faulty voltage regulator module.
4. Faulty stator and/or rotor.

### Speedometer Operates Erratically

1. Contaminated vehicle speed sensor (remove sensor and clean off metal particles).
2. Loose connections.

## TRANSMISSION

### Shifts Hard

1. Clutch dragging slightly.
2. Shifter return spring (inside transmission) bent or broken.
3. Bent shifter rod.

4. Shifter forks (inside transmission) sprung.
5. Corners worn off shifter clutch dogs (inside transmission).
6. Hydraulic clutch circuit not bled correctly.

### Jumps Out Of Gear

1. Shifter rod improperly adjusted.
2. Shifter drum (inside transmission) damaged.
3. Shifter engaging parts (inside transmission) badly worn and rounded.
4. Shifter forks bent.
5. Damaged gears.

### Clutch Slips

1. Insufficient clutch spring tension.
2. Worn friction discs.

### Clutch Drags Or Does Not Release

1. Lubricant level too high in sump.
2. Clutch spring tension.
3. Clutch discs warped.
4. Clutch spacer missing or installed backwards.

### Clutch Chatters

Friction discs or steel discs worn or warped.

## HANDLING

### Irregularities

1. Improperly loaded motorcycle. Non-standard equipment on the front end such as heavy radio receivers, extra lighting equipment or luggage tends to cause unstable handling.
2. Damaged tire(s) or improper front-rear tire combination.
3. Irregular or peaked front tire tread wear.
4. Incorrect tire pressure. See 1.13 TIRES AND WHEELS
5. Shock absorber not functioning normally.
6. Loose wheel axle nuts. Tighten to recommended torque specification.
7. Excessive wheel hub bearing play.
8. Rear wheel out of alignment with frame and front wheel.
9. Steering head bearings improperly adjusted. Correct adjustment and replace pitted or worn bearings and races. See 1.21 STEERING HEAD BEARINGS
10. Tire and wheel unbalanced.
11. Rims and tires out-of-round or eccentric with hub.
12. Rims and tires out-of-true sideways.
13. Rear fork loose on pivot shaft.

## BRAKES

### Brake Does Not Hold Normally

1. Master cylinder reservoir low on fluid, system leaking or pads worn.
2. Brake system contains air bubbles.
3. Master cylinder or caliper piston seals worn or parts damaged.
4. Brake pads contaminated with grease or oil.
5. Brake pads badly worn.
6. Brake disc badly worn or warped.
7. Brake drags - insufficient brake pedal or hand lever free-play, caliper piston worn or damaged, or excessive brake fluid in reservoir.
8. Brake fades due to heat build up - brake pads dragging or excessive braking.
9. Brake fluid leak when under pressure.

| SUBJECT | PAGE NO. |
|---|---|
| 2.1 SPECIFICATIONS: CHASSIS | 2-1 |
| 2.2 VEHICLE IDENTIFICATION NUMBER (V.I.N.) | 2-3 |
| 2.3 FRAME AND LOWER FRAME RAILS | 2-5 |
| 2.4 FRONT ENGINE MOUNT | 2-7 |
| 2.5 FRONT ENGINE MOUNT ASSEMBLY | 2-8 |
| 2.6 REAR ENGINE MOUNTS | 2-10 |
| 2.7 ENGINE REPLACEMENT | 2-11 |
| 2.8 FOOTRESTS AND FOOT CONTROLS: FORWARD MOUNT | 2-19 |
| 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT | 2-21 |
| 2.10 PASSENGER FOOTRESTS | 2-23 |
| 2.11 THROTTLE CABLES | 2-24 |
| 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR | 2-26 |
| 2.13 CLUTCH HAND LEVER | 2-29 |
| 2.14 CLUTCH FLUID LINE | 2-30 |
| 2.15 SECONDARY CLUTCH ACTUATOR | 2-31 |
| 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR | 2-33 |
| 2.17 FRONT BRAKE CALIPER | 2-37 |
| 2.18 REAR BRAKE MASTER CYLINDER AND RESERVOIR: FORWARD CONTROLS | 2-39 |
| 2.19 REAR BRAKE RESERVOIR: MID-MOUNT CONTROLS | 2-43 |
| 2.20 REAR BRAKE MASTER CYLINDER: MID-MOUNT CONTROLS | 2-44 |
| 2.21 REAR BRAKE CALIPER | 2-48 |
| 2.22 HANDLEBARS: VRSCAW | 2-49 |
| 2.23 HANDLEBARS: ALL EXCEPT VRSCAW | 2-51 |
| 2.24 FRONT WHEEL | 2-53 |
| 2.25 WHEEL LACING | 2-58 |
| 2.26 TRUING LACED WHEELS | 2-62 |
| 2.27 REAR WHEEL | 2-64 |
| 2.28 SEALED WHEEL BEARINGS | 2-69 |
| 2.29 DISC RIM RUNOUT | 2-72 |
| 2.30 TIRES | 2-73 |
| 2.31 WHEEL ALIGNMENT | 2-75 |
| 2.32 FRONT FENDER | 2-78 |
| 2.33 FRONT FORK | 2-79 |
| 2.34 STEERING HEAD | 2-84 |
| 2.35 FORK LOCK | 2-87 |
| 2.36 BELT GUARD AND DEBRIS DEFLECTOR | 2-88 |
| 2.37 REAR SHOCK ABSORBERS | 2-89 |
| 2.38 SWINGARM | 2-91 |
| 2.39 SEAT | 2-96 |
| 2.40 REAR FENDER | 2-98 |
| 2.41 JIFFY STAND | 2-99 |

# NOTES

## GENERAL

**Table 2-1. Dimensions: 2008 VRSC Models**

| ITEM | VRSCAW | | VRSCD | | VRSCDX | |
|---|---|---|---|---|---|---|
| | IN. | MM | IN. | MM | IN. | MM |
| Wheelbase | 67.20 | 1706.88 | 67.20 | 1706.88 | 67.20 | 1706.88 |
| Overall length | 94.40 | 2397.76 | 94.40 | 2397.76 | 94.40 | 2397.76 |
| Overall width | 34.50 | 876.30 | 37.30 | 947.42 | 34.60 | 878.84 |
| Overall height | 47.70 | 1211.58 | 45.00 | 1143.00 | 45.50 | 1155.70 |
| Road clearance | 5.00 | 127.00 | 5.00 | 127.00 | 4.20 | 106.68 |
| Saddle height* | 26.00 | 660.40 | 26.00 | 660.40 | 25.20 | 640.08 |
| *With 180 lb. (82 kg) rider on seat. | | | | | | |

**Table 2-2. Weights: 2008 VRSC Models**

| ITEM | VRSCAW, VRSCD | | VRSCAWA, VRSCDA | | VRSCDX | | VRSCDXA | |
|---|---|---|---|---|---|---|---|---|
| | LB. | KG | LB. | KG | LB. | KG | LB. | KG |
| Weight (as shipped from factory) | 637 | 289 | 641 | 291 | 643 | 291.6 | 647 | 293 |
| GVWR | 1075 | 488 | 1075 | 488 | 1075 | 488 | 1075 | 488 |
| GAWR Front | 377 | 171 | 377 | 171 | 377 | 171 | 377 | 171 |
| GAWR Rear | 698 | 317 | 698 | 317 | 698 | 317 | 698 | 317 |

*NOTE*

*Gross Vehicle Weight Rating (GVWR) (maximum allowable loaded vehicle weight) and corresponding Gross Axle Weight Ratings (GAWR) are given on a label located on the left front frame cross tube.*

**Table 2-3. Capacities: 2008 VRSC Models**

| ITEM | U.S. | LITERS |
|---|---|---|
| Fuel tank | 5.0 gal | 18.93 |
| Low fuel warning lamp on | 1.0 gal | 3.8 |
| Oil capacity with filter | 4.5 qt. | 4.26 |
| Coolant capacity | 2.50 qt. | 2.37 |

**Table 2-4. Wheel, Brake Disc and Tire Runout**

| RUNOUT | MM | IN |
|---|---|---|
| Wheel - rim lateral | 0.76 | 0.030 |
| Wheel - rim radial | 0.76 | 0.030 |
| Front brake disc - lateral | 0.3 | 0.012 |
| Rear brake disc - lateral | 0.3 | 0.012 |
| Tire - lateral | 1.52 | 0.060 |
| Tire - radial | 2.29 | 0.090 |

**Table 2-5. Tire Sizes: 2008 VRSC Models**

| MODEL | MOUNT | SIZE | NUMBER |
|---|---|---|---|
| VRSCAW | Front | 19 in. | D208F 120/70ZR19 60W |
| | Rear | 18 in. | D419 240/40R18 79V |
| VRSCD | Front | 19 in. | D208F 120/70ZR19 60W |
| | Rear | 18 in. | D207 180/55ZR18 74W |

**Table 2-5. Tire Sizes: 2008 VRSC Models**

| MODEL | MOUNT | SIZE | NUMBER |
|---|---|---|---|
| VRSCDX | Front | 19 in. | D208F 120/70ZR19 60W |
| | Rear | 18 in. | D419 240/40R18 79V |
| All 2008 models use Dunlop radial tires only. | | | |

**WARNING**

**Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)**

**Table 2-6. Tire Pressures: 2008 VRSC Models**

| MODEL | LOAD | TIRE PRESSURE (COLD) | | | |
|---|---|---|---|---|---|
| | | FRONT | | REAR | |
| | | PSI | kPa | PSI | kPa |
| VRSCAW, VRSCDX | solo rider | 36 | 248 | 38 | 262 |
| | rider and passenger | 36 | 248 | 42 | 290 |
| VRSCD | solo rider | 36 | 248 | 38 | 262 |
| | rider and passenger | 36 | 248 | 40 | 276 |

**WARNING**

**Match tires, tubes, air valves and caps to the correct wheel rim. Contact a Harley-Davidson dealer. Mismatching can result in damage to the tire bead, allow tire slippage on the rim or cause tire failure, which could result in death or serious injury. (00023a)**

*NOTE*

*See 1.13 TIRES AND WHEELS for important information regarding tires.*

**WARNING**

**Use only Harley-Davidson approved tires. See a Harley-Davidson dealer. Using non-approved tires can adversely affect stability, which could result in death or serious injury. (00024a)**

- Use tubeless tires on all Harley-Davidson disc wheels.
- Do not use inner tubes in radial tires.
- Always use the correct size tires. Tire sizes are molded on the tire sidewall.

## VEHICLE IDENTIFICATION NUMBER: VRSC MODELS

See Figure 2-1. The full 17-digit serial or Vehicle Identification Number (V.I.N.) is stamped on the steering head and on a label located on the left frame tube above the front engine cylinder.

An abbreviated V.I.N. is stamped on the left side crankcase above the sump.

*NOTE*

*Always give the full 17-digit Vehicle Identification Number when ordering parts or making any inquiry about your motorcycle.*

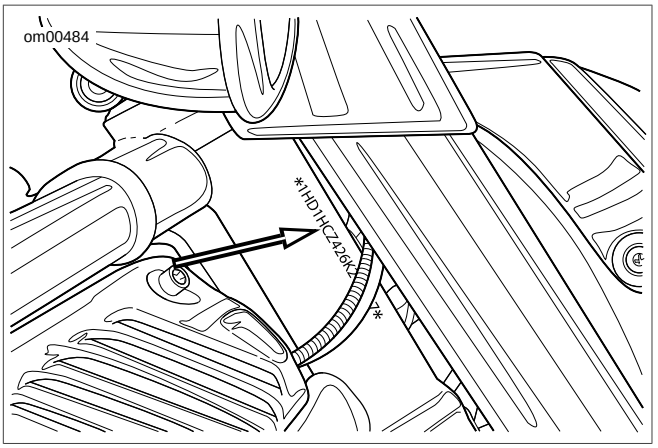



**Figure 2-1. V.I.N. Stamping Location: VRSC Models**

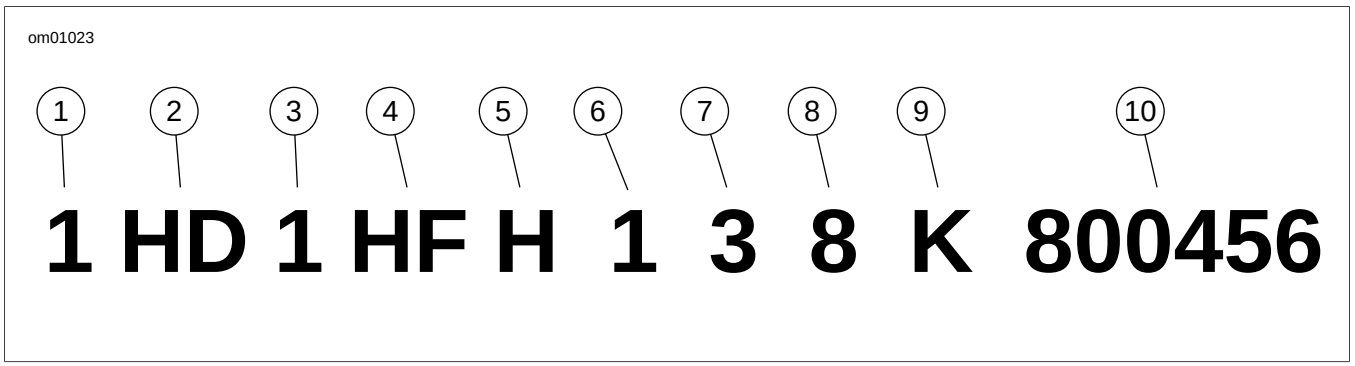



**Figure 2-2. Typical Harley-Davidson V.I.N.: 2008 VRSC Models**

**Table 2-7. Harley-Davidson V.I.N. Breakdown: 2008 VRSC Models**

| POSITION | DESCRIPTION | POSSIBLE VALUES |
|---|---|---|
| 1 | Market designation | 1=Originally manufactured for sale **within** the United States<br>5=Originally manufactured for sale **outside** of the United States |
| 2 | Manufacturer | HD=Harley-Davidson |
| 3 | Motorcycle type | 1=Heavyweight motorcycle (901 cc and larger) |
| 4 | Model | HD=VRSCD Night Rod™<br>HF=VRSCAW V-Rod®<br>HH=VRSCDX Night Rod Special™<br>HK=VRSCAWA V-Rod® with ABS<br>HL=VRSCDA Night Rod™ with ABS<br>HM=VRSCDXA Night Rod Special™ with ABS |
| 5 | Engine type | H=Revolution®, 1250 cc liquid-cooled, fuel injected<br>J=Revolution®, 1250 cc liquid-cooled, fuel injected 105 HP HDI only |
| 6 | Introduction date | 1=Regular<br>2=Mid-year<br>3=California/regular<br>4=Cosmetic changes and/or special introductory date<br>5=California/cosmetic changes and/or special introductory date<br>6=California/mid-year |
| 7 | V.I.N. check digit | Can be 0-9 or X |
| 8 | Model year | 8=2008 |

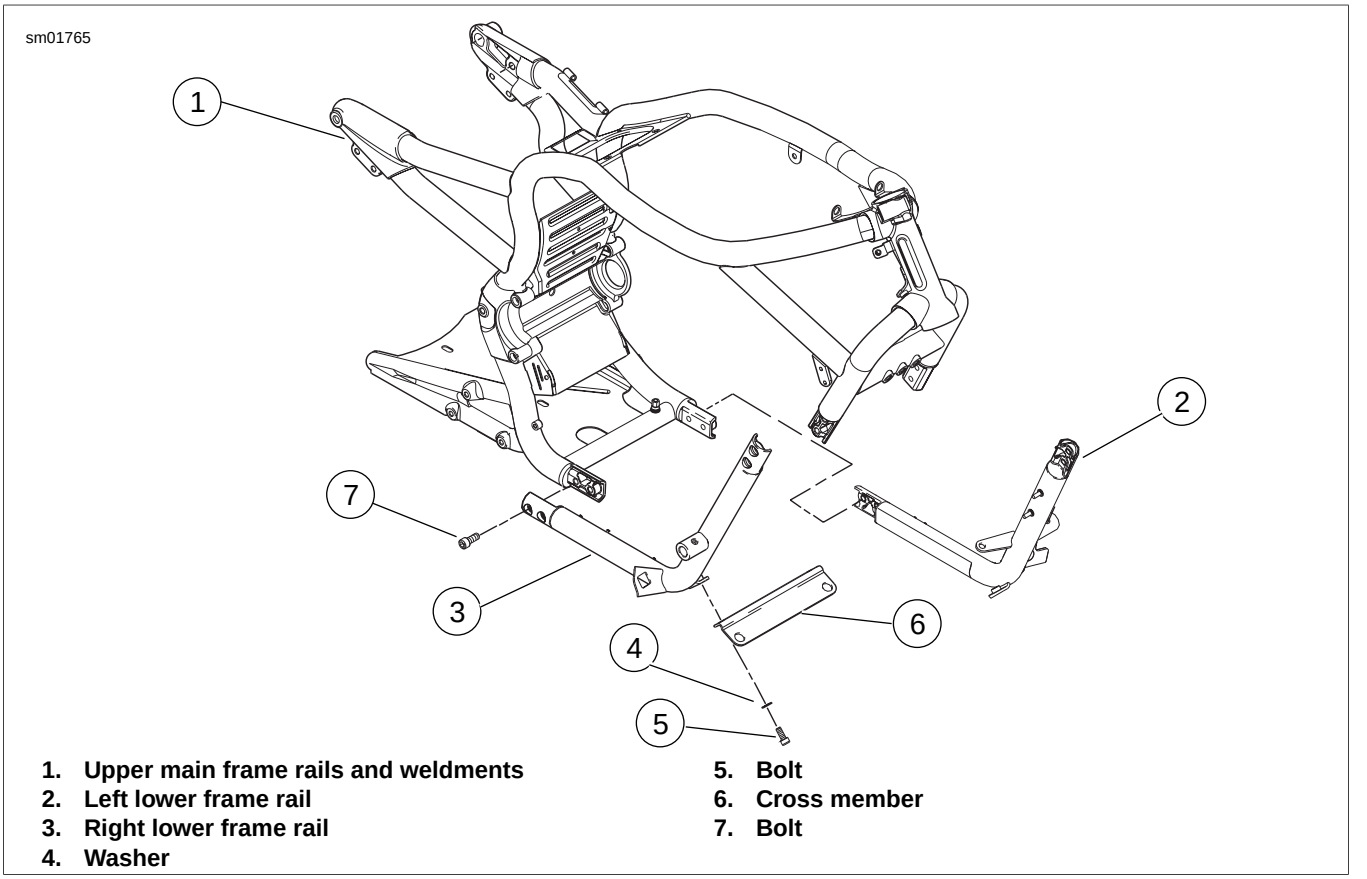
**Table 2-7. Harley-Davidson V.I.N. Breakdown: 2008 VRSC Models**

| POSITION | DESCRIPTION | POSSIBLE VALUES |
|---|---|---|
| 9 | Assembly plant | K=Kansas City, MO USA |
| 10 | Sequential number | Varies |

## GENERAL

The steel upper hydroformed main rails, joined with stamped sheet metal weldments for the steering head, seat, swingarm pivots, fuel tank shield, and rear fender, are bolted to left and right lower frame rails that complete the frame perimeter.

The rider footrests and foot controls are mounted on the lower frame near the swingarm pivot. The passenger footrests are mounted on the rear frame rails next to the fuel tank.




1. **Upper main frame rails and weldments**
2. **Left lower frame rail**
3. **Right lower frame rail**
4. **Washer**
5. **Bolt**
6. **Cross member**
7. **Bolt**

**Figure 2-3. Steel Perimeter Frame and Bolt-on Lower Frame Rails**

## REMOVAL

1. Support motorcycle under fuel tank frame weldment and/or lock wheels so that frame rails and/or engine can be removed.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat.
4. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

5. Disconnect negative battery cable.
6. See Figure 2-3. Remove two cross member bolts (5) and washers (4). Pull bottom of radiator assembly forward with cross member or remove the radiator assembly as required. See 6.8 RADIATOR AND OIL COOLER.
7. Remove fluid lines from clips on right lower frame rail. See 2.14 CLUTCH FLUID LINE.
8. Remove engine mount stabilizer link from frame rail bracket. See 2.4 FRONT ENGINE MOUNT.

*NOTE*

*Maintain stabilizer link length for reinstallation. Do not loosen jam nuts on stabilizer link.*

9. Remove bolts (7) holding on the right and left lower frame rails (2, 3). Remove the frame rails.

## INSTALLATION

1. See Figure 2-3. Install left and right lower frame rails (2, 3) and finger tighten mounting bolts (7).
2. Using clips, attach clutch fluid line to right lower frame rail. See 2.14 CLUTCH FLUID LINE.

3. Attach the engine mount stabilizer link to the frame tab. Tighten to 34-41 Nm (25-30 ft-lbs) See 2.4 FRONT ENGINE MOUNT.
4. Attach starter solenoid bracket to right lower frame rail with nuts. Tighten to 6-10 Nm (53-88 **in-lbs**) .
5. Reinstall radiator/oil cooler assembly as required or pull radiator/oil cooler assembly into position and install and finger tighten cross member mounting bolts (5) and washers (4). Tighten to 20-26 Nm (15-19 ft-lbs) See 6.8 RADIATOR AND OIL COOLER.
6. Tighten lower frame rail bolts (7) to 61-75 Nm (45-55 ft-lbs)
7. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**) .
8. Reinstall airbox cover.
9. Install maxi-fuse and right side cover.

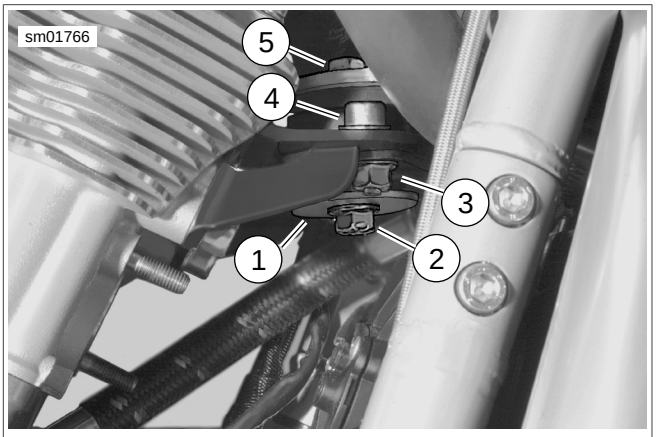
## REPLACEMENT

1. Support engine with a scissors jack under the oil pan.
2. Remove the right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat.
4. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

5. Disconnect negative battery cable.
6. See Figure 2-4. Loosen and remove nut (2) and travel limiting washer (1) from center mounting bolt (5).
7. Loosen and remove nuts (3) from engine mount bolts (4) (Left side requires using a 8 mm ball Allen with a 2 in. extension).
8. By lifting up the center mounting bolt (5) slightly, the engine mount pivots down and out away from the fan shroud.
9. Install **new** engine mount and left and right engine mounting bolts (4).
10. Install travel limiting washer (1) and center mounting bolt nut (2).
11. Tighten all fasteners to 34-41 Nm (25-30 ft-lbs) .
12. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**) .
13. Reinstall airbox cover.
14. Close seat.
15. Install maxi-fuse and right side cover.




1. **Travel limiting washer**
2. **Center mounting bolt nut**
3. **Engine mount bolt nut**
4. **Engine mount bolt and washer**
5. **Center mounting bolt**

**Figure 2-4. Engine Mount (Exhaust Removed for Clarity)**

## REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Open seat.
3. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

4. Disconnect negative battery cable.
5. Remove radiator assembly as required. See 6.8 RADIATOR AND OIL COOLER.
6. See Figure 2-5. Loosen and remove double threaded studs (11) that hold front engine mount bracket (3) to frame.
7. Remove bolts (10) that hold front engine mount bracket (4) to engine and work assembly out of frame between two lower frame rails.
8. Loosen and remove stabilizer link hold down bolt (12) to lower frame rail bracket.
9. Loosen and remove bolt (16), spacer (17) and stabilizer link (15) from front of engine case.

*NOTE*

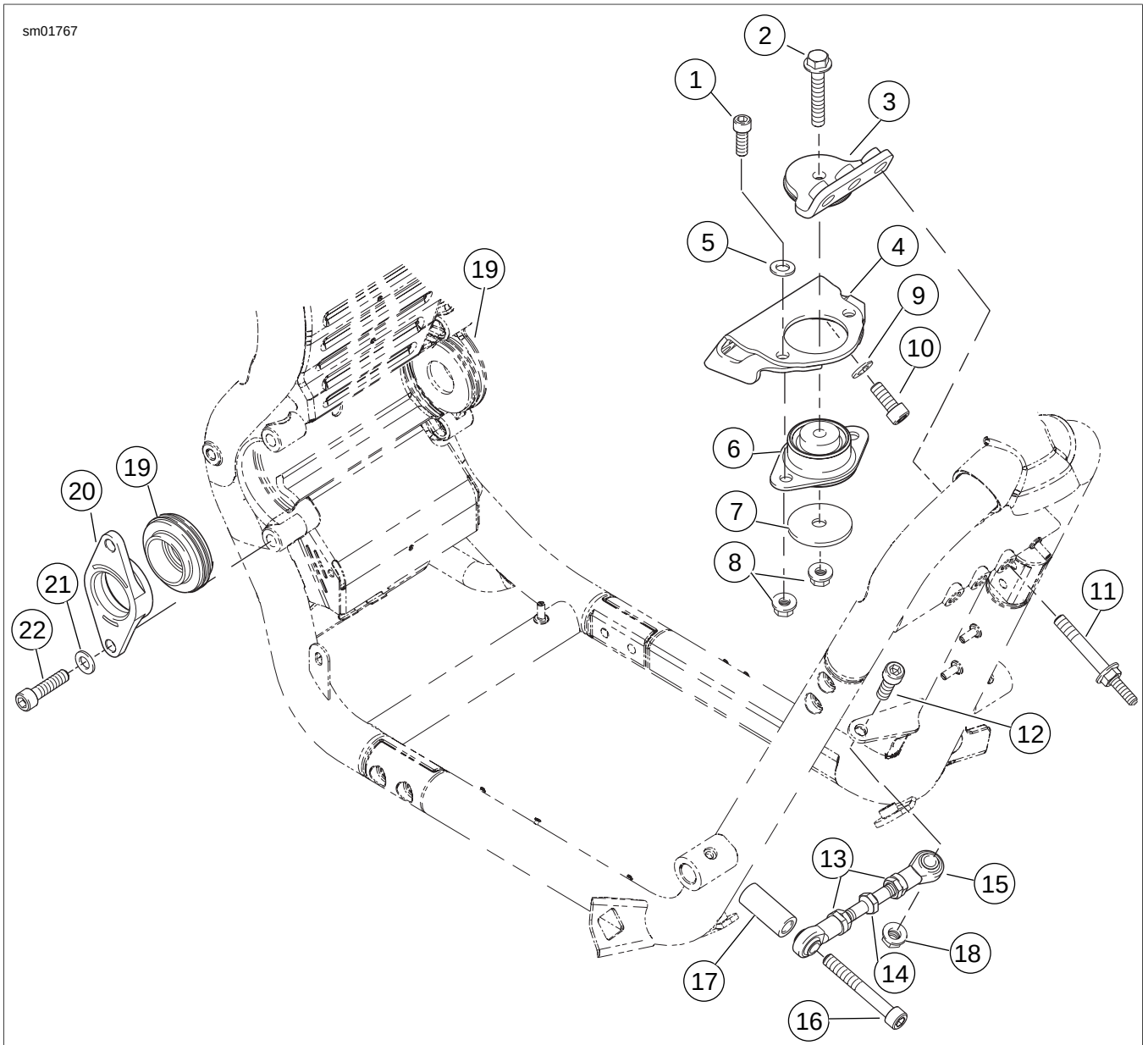
*Maintain stabilizer link length for a correctly aligned reinstallation. Do not loosen jam nuts and turn rod ends.*

## DISASSEMBLY AND ASSEMBLY

1. See Figure 2-5. Loosen and remove nut (8) from center mounting bolt (2) holding engine mount (6), travel limiting washer (7) and the two brackets (3, 4) together.
2. Remove two bolts (1) holding engine mount (6) to engine mount bracket (4). Remove engine mount (6).
3. Inspect for worn or damaged parts, replace as necessary.
4. Align engine mount bolt (2) through the frame bracket (4) and the engine mount (6) with the flange of the engine mount under the engine bracket and the large end up through the engine bracket. Slide on the travel limiting washer (7) and loosely install the flanged hex-nut (8).
5. Install and tighten fasteners (1), washers (5) and nuts (8) holding engine mount (6) to bracket to 34-41 Nm (25-30 ft-lbs) .

## INSTALLATION

1. See Figure 2-5. Start, but do not tighten bolts (10) and washers (9) fastening engine mount bracket (4) to engine cylinder head.
2. Attach frame bracket to frame with double threaded studs.
3. Alternately tighten and loosen engine mount bolts (10) and the two threaded studs (11). Tighten the engine bolts (10) to 34-41 Nm (25-30 ft-lbs). Tighten the two threaded studs (11) to 34-41 Nm (25-30 ft-lbs).
4. Tighten center mounting bolt (2) and travel limiting washer to 34-41 Nm (25-30 ft-lbs).
5. Insert bolt through stabilizer link (15) and spacer (17) and thread into engine crankcase. Tighten bolt to 34-41 Nm (25-30 ft-lbs).
6. Install frame end of stabilizer link (15) to frame bracket. Tighten to 34-41 Nm (25-30 ft-lbs).
7. Reinstall radiator assembly. See 6.8 RADIATOR AND OIL COOLER.
8. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
9. Install airbox cover.
10. Close seat.
11. Install maxi-fuse and right side cover.




1. **Bolt**
2. **Center mounting bolt**
3. **Bracket front engine mount - frame**
4. **Bracket front engine mount - engine**
5. **Washer**
6. **Front engine mount**
7. **Washer - travel limiting**
8. **Nut**
9. **Washer**
10. **Bolt**
11. **Double threaded stud**
12. **Bolt**
13. **Jam nut**
14. **Fixed nut**
15. **Stabilizer link**
16. **Bolt**
17. **Spacer**
18. **Nut**
19. **Rear engine mount**
20. **Bracket - rear engine mount**
21. **Washer**
22. **Fasteners**

**Figure 2-5. Engine Mounts (typical)**

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45317 | ENGINE ASSEMBLY SUPPORT FIXTURE |

1. Support motorcycle under fuel tank frame weldment and lock the front wheel so that the engine can be removed.

*NOTE*

*To provide clearance and alignment, locate a scissors style jack under the fuel tank frame extensions to raise or lower the motorcycle throughout the procedure.*

2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat.
4. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

5. Disconnect negative battery cable.
6. With ENGINE ASSEMBLY SUPPORT FIXTURE (Part No. HD-45317) positioned under engine, remove engine from motorcycle and roll far enough from frame to remove left rear engine mount. See 2.7 ENGINE REPLACEMENT.
7. See Figure 2-5. Remove fasteners (22) holding right rear engine mount bracket (20) to the frame.
8. Remove both rear engine mounts (19) with left and right pivot shaft spacers. See 2.38 SWINGARM.
9. Clean as necessary the right rear engine mount frame weldment, and the rear engine mount bracket.

## INSTALLATION

1. See Figure 2-5. Install left rear engine mount (19) in left side frame weldment.
2. Install pivot shaft spacer in left rear engine mount. See 2.38 SWINGARM.
3. Orient flanged side of right rear engine mount (19) toward outside of the rear engine mount bracket (20), and thread fasteners (22) with narrow washers (21) through rear engine mount bracket into frame bosses.
4. Install pivot shaft spacer in right engine mount.
5. Tighten mounting bolts (22) to 34-41 Nm (25-30 ft-lbs).

*NOTE*

*The left and right Swingarm pivot shaft spacers are inserted into the engine mounts. Verify that the pivot shaft spacers are in position before installation of the pivot shaft.*

6. Reinstall engine. See 2.7 ENGINE REPLACEMENT.
7. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**) .
8. Install airbox cover.
9. Close seat.
10. Reinstall maxi-fuse and right side cover.

## GENERAL

Removal and replacement of the engine may be required for either replacement engines or for engine overhaul.

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-43517 | ENGINE ASSEMBLY SUPPORT FIXTURE |
| PART NO. HD-45317 | ENGINE ASSEMBLY SUPPORT FIXTURE |

1. See Figure 2-6. On a table lift with a LIFT SIDE EXTENSION, position a scissors jack under the fuel tank.

*NOTE*

*To provide clearance and alignment, locate a scissors style jack under the fuel tank frame extensions to raise or lower the motorcycle throughout the procedure.*

**WARNING**

**To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)**

2. Allow engine to cool.
3. Open seat.
4. Purge fuel supply line of high pressure gasoline.
   a. Disconnect fuel module connector from top plate.
   b. In neutral, start engine and allow engine to run.
   c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.
5. Place a suitable container under engine, loosen oil drain plug and drain oil.
6. Install and tighten oil drain plug to 35 Nm (25 ft-lbs).
   a. For replacement engines, leave oil filter threaded into its mounting plate.
   b. For engine overhaul, remove oil filter as necessary.

*NOTE*

*Dispose of oil in accordance with local regulations.*

7. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

8. Disconnect negative and positive battery cables from battery. See 1.9 BATTERY MAINTENANCE.

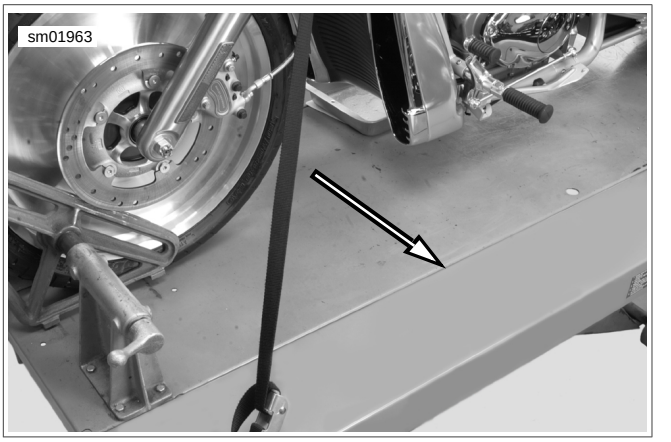



**Figure 2-6. Lift Side Extension (typical)**

9. Remove air filter top, air filter, breather hose, velocity stacks, and air filter bottom. Unscrew threaded air filter hold down rod from throttle body. 1.5 AIR CLEANER AND EXHAUST SYSTEM.
10. At the fuel rail, disconnect pressure fuel line and return fuel line by pressing blue buttons with thumb and first finger.
11. See Figure 2-8. Disconnect copper L-bracket (1) with negative battery cable from front cylinder head.
12. Remove fastener on rear cylinder head and remove GND 1 (8), GND 2 (9) and horn ground wire (10). Replace fastener.
13. Remove fastener on front cylinder head and remove regulator ground (3). Replace fastener.
14. Separate wiring connectors from horn. Unbolt and remove horn from rubber grommet on frame. See 8.21 HORN.
15. Separate:
   a. Front (2) and rear coil connectors [83F, 83R].
   b. Main engine connector [45] (7).
   c. Throttle position sensor [88] (4).
   d. Idle air control actuator [87] (5).
16. For a California model, pull the purge solenoid hose (6) off throttle body.
17. Perform throttle body procedure:
   a. For a replacement engine, loosen throttle cable adjustor jam nuts. Turn throttle cable adjuster until cable is as short as possible. Remove throttle cable housings from guides at the throttle body and remove cable barrels from throttle cam.
   b. See Figure 2-7. For engine overhaul, loosen clamps at each intake and lift throttle body straight up. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine. Cover intake openings to prevent objects from falling into intake bore.

18. Remove exhaust system. See appropriate section for your model motorcycle.
19. Remove lower left and right side radiator covers. See 6.8 RADIATOR AND OIL COOLER.
20. See Figure 2-9. Separate the following items:
    a. Crank position sensor connector [79] (3).
    b. Top and bottom cooling fan connectors [97T] [97B] (2).
    c. Stator-to-regulator connector [46] (1).
    d. Wiring frame clip.

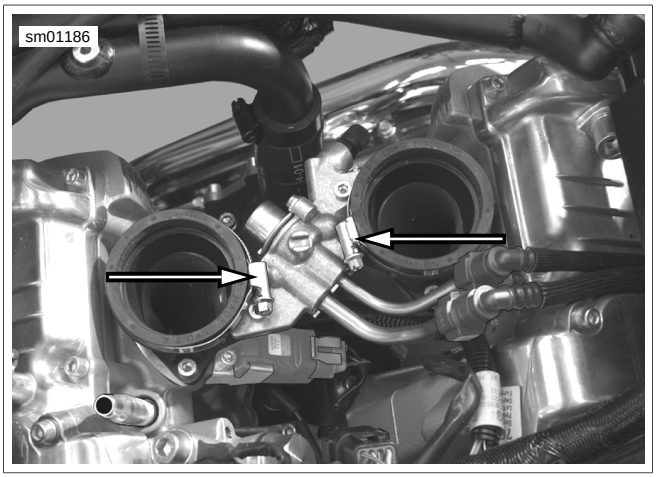



**Figure 2-7. Intake Clamps, Throttle Body Removed (typical)**

*NOTE*

*Note the position of the clamps for assembly.*

21. See Figure 2-10. Cover front fender with a shop towel or protective cover. On right side, pull rear brake fluid reservoir from radiator cover.
22. Remove two fasteners and washers (2) on each side of radiator cover and remove radiator cover. The radiator cover includes two chrome inlet bezels.
23. Place a suitable container under radiator and open pressure cap.
24. See Figure 2-10. Loosen but do not remove radiator drain plug. Orient radiator drain plug so that slot in threads is open to container.

**⚠ WARNING**

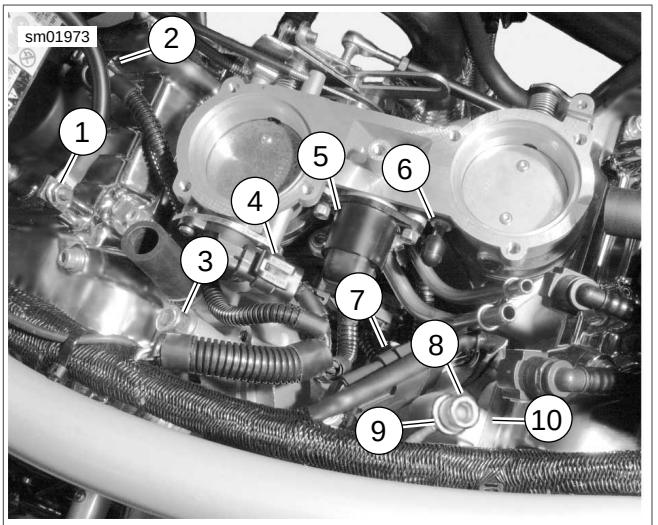
**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

25. Loosen radiator cap and allow coolant to drain from the radiator.
26. See Figure 2-11. Place a suitable container under engine and remove front engine coolant drain plug. Allow remaining coolant to drain from engine.
27. Install front engine drain plug and tighten to 9.7 Nm (86 **in-lbs**).
28. Hand tighten radiator drain plug.

*NOTE*

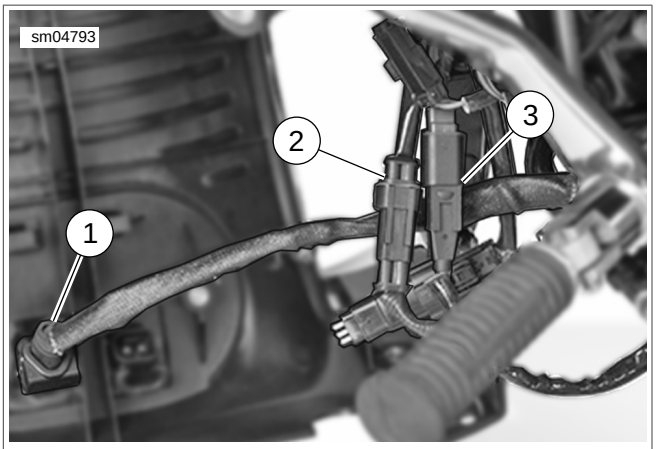
*Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 **in-lbs**). See 6.3 ENGINE COOLANT.*

29. Use a long thin screwdriver (Snap-on Part No. SDD1410) to loosen worm drive clamps on radiator hoses.




1. **Negative battery cable copper L-bracket**
2. **Front cylinder coil connector**
3. **Regulator ground**
4. **Throttle position sensor connector [88]**
5. **Idle air control actuator connector [87]**
6. **Purge solenoid fitting**
7. **Main engine connector [45]**
8. **GND 1**
9. **GND 2**
10. **Horn ground wire**

**Figure 2-8. Wiring Connections (typical)**




1. **Stator-to regulator connector**
2. **Top & bottom fan power connectors**
3. **Crank position sensor connector**

**Figure 2-9. Left Side Wiring Connectors (typical)**

30. Loosen and remove cross member fasteners holding the bottom of the radiator/oil cooler assembly on both sides.
31. Put radiator/oil cooler assembly forward at the bottom. Separate oil lines from crankcase (oil in) and oil filter (oil out) fittings. See 6.7 OIL LINE FITTINGS.
32. Remove radiator/oil cooler assembly. See 6.8 RADIATOR AND OIL COOLER.
33. Remove engine coolant pipes. See 6.6 COOLANT PIPES AND HOSES.

*NOTE*

*Dispose of antifreeze in accordance with local regulations.*

34. Remove drive sprocket cover.

*NOTE*

*Remove debris deflector/belt guard, if required, for clearance. See 2.36 BELT GUARD AND DEBRIS DEFLECTOR.*

35. See Figure 2-12. Loosen retaining bolts (3) holding drive sprocket (1) to sprocket mounting flange.

*NOTE*

*Do not remove the output shaft flange nut (4).*

36. Remove snap ring and loosen rear wheel axle nut. Move wheel forward and slip belt off wheel sprocket. Pull belt off of drive sprocket.
37. See Figure 2-12. Remove retaining bolts (3) from drive sprocket. Discard bolts (3).
38. Rotate sprocket (1) to fit spoke pattern of mounting flange (2) and remove sprocket (1).
39. Remove secondary clutch actuator cover and secondary clutch actuator. See 2.15 SECONDARY CLUTCH ACTUATOR.

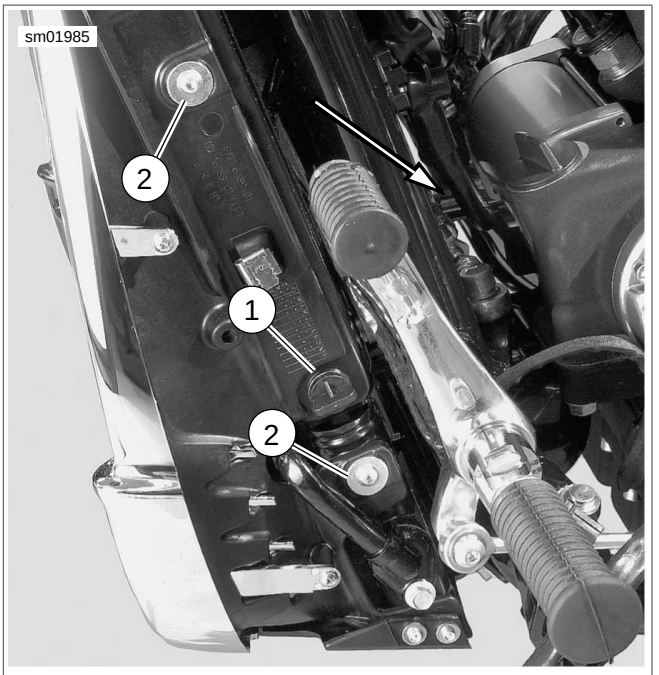
*NOTE*

*It is not necessary to loosen flare nut or to remove clutch fluid line from the secondary clutch actuator. Allow secondary clutch actuator to hang from clutch fluid line.*

40. At front of engine, pull back solenoid cable protective boot from starter post and loosen and remove nut. Remove solenoid cable terminal ring. See 5.4 STARTER.
41. Remove nuts holding starter solenoid to frame and pull solenoid off of frame studs. See 5.5 STARTER SOLENOID.

*NOTE*

*To avoid strain on solenoid green and black wire leads, locate connector under left side cover and press on release square to separate connector halves.*




**1. Drain plug**
**2. Cover fastener and washer**

**Figure 2-10. Radiator Cover Left Side (typical)**

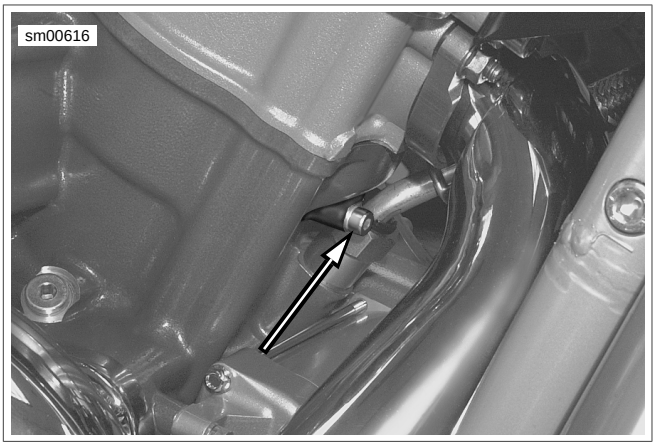



**Figure 2-11. Front Cylinder Coolant Drain Plug @ 9.7 Nm (86 in-lbs)**

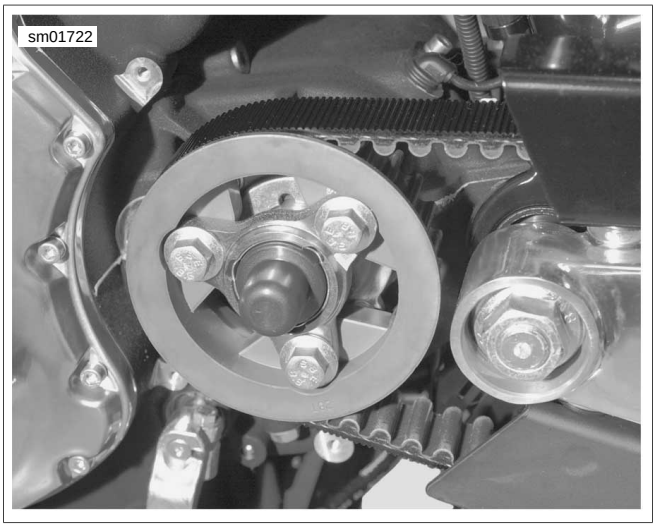



**Figure 2-12. Drive sprocket**

42. See Figure 2-13. Jack up motorcycle and position ENGINE ASSEMBLY SUPPORT FIXTURE (Part No. Part No. HD-45317) under engine. Align the two hex socket-head bolts (2) at rear of fixture with mounting screw detents at bottom rear of oil pan. Align the two separated hex head bolts (1) on each side of front of fixture with corresponding mounting screw detents on sides of oil pan. Using scissors jack, lower motorcycle until engine oil pan screw detents rest on hex socket-head bolts.
43. Remove nut and travel limiting washer from center engine mount bolt. Remove center mounting bolt.
44. Remove fasteners holding front engine mount bracket to engine.
45. Remove upper radiator studs securing frame engine mount bracket to frame. Pull front engine mount assembly forward through frame rails.
46. Remove stabilizer link bolt from frame bracket. See 2.4 FRONT ENGINE MOUNT.

*NOTE*

*Maintain stabilizer link length for reinstallation. Do not loosen jam nuts on stabilizer link.*

47. Remove Swingarm pivot nut and slide out pivot shaft. Swingarm can be left in place.
48. Loosen fasteners holding rear engine mount bracket. See 2.6 REAR ENGINE MOUNTS.
49. Remove shifter linkage from engine shifter arm on transmission.
50. Remove engine ground cable from frame.
51. Remove lower left frame rail and stabilizer link attached. See 2.3 FRAME AND LOWER FRAME RAILS.

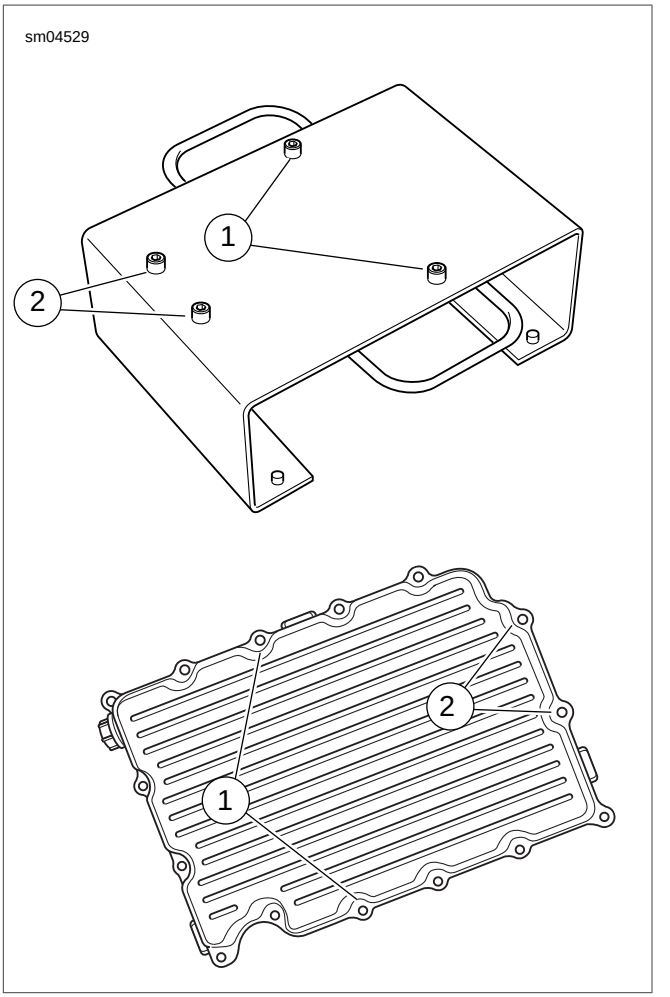



**Figure 2-13. Engine Assembly Support Fixture Alignment**

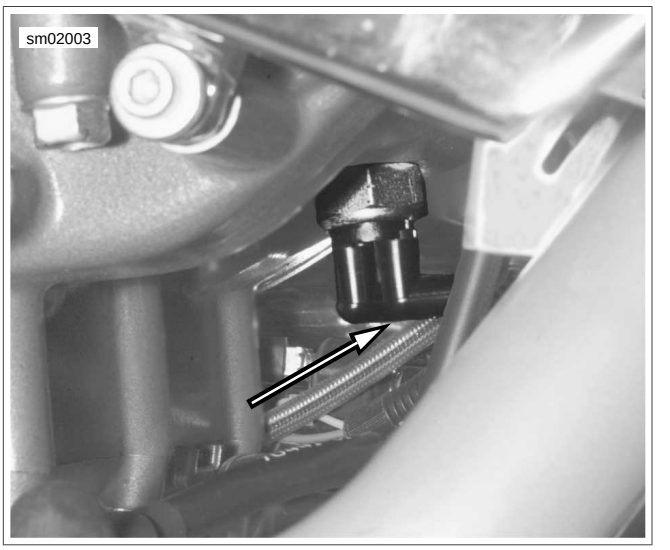



**Figure 2-14. Neutral Light Sender Connectors [131]**

*NOTE*

*To move engine on support fixture, support engine and pull on fixture handles.*

52. With engine resting in ENGINE ASSEMBLY SUPPORT FIXTURE (Part No. HD-43517), gently pull on handles to work engine partially out of left side of frame.
53. See Figure 2-14. Pull connectors to neutral light sender [131] under drive sprocket.

*NOTE*

*The neutral light sender stays in the engine.*

54. Pull purge solenoid hose off of charcoal canister (California models only).
55. See Figure 2-15. Pull connectors from stoplamp switch [121] for VRSCAW models.
56. See Figure 2-16. Pull connectors from stoplamp switch [121] for VRSCD models.
57. Pull electrical harness to stoplamp switch and purge solenoid hose (California models only) through top of the cavity in engine cases.
58. See Figure 2-17. Disconnect vehicle speed sensor wire from connector [65] at vehicle speed sensor.

*NOTE*

*The vehicle speed sensor and wire connector [65] stay attached to the engine.*

59. With fixture handles, pull engine out of frame onto left side extension.
60. See Figure 2-18. Engine may be secured with straps for hoisting.
61. If replacing engine with a new engine, proceed to 2.7 ENGINE REPLACEMENT, Installation. If rebuilding engine, mount engine on stand and proceed to 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING.

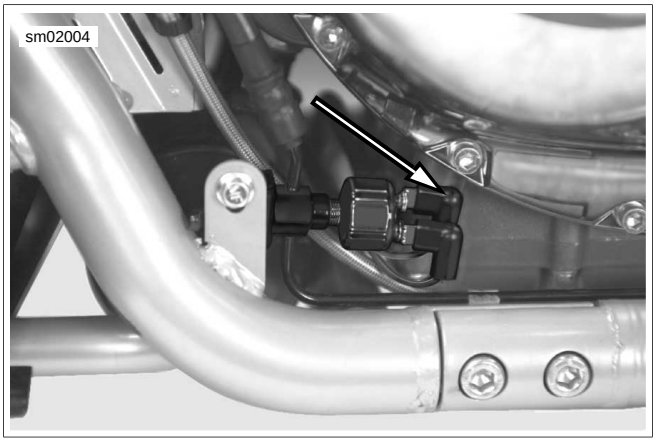



**Figure 2-15. Stoplamp Switch Connectors (forward-mount control models) [121]**

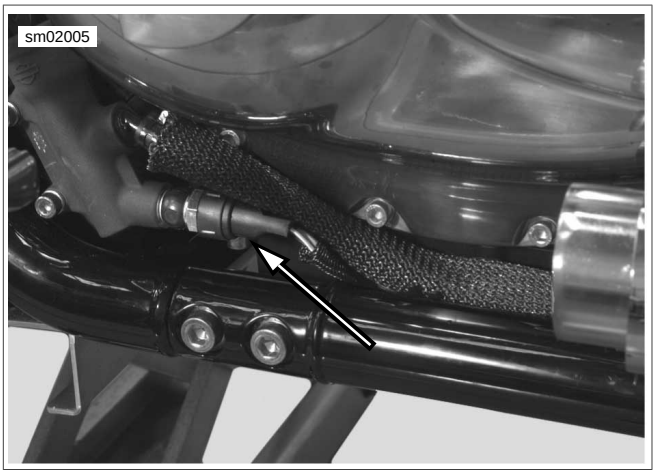



**Figure 2-16. Stoplamp Switch Connectors (mid-mount control models) [121]**

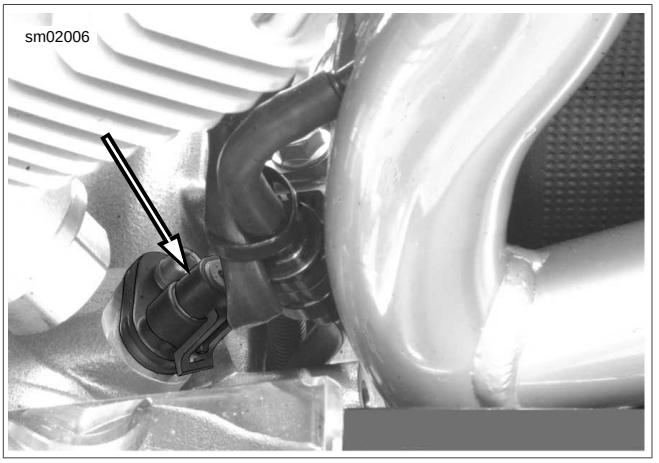



**Figure 2-17. Vehicle Speed Sensor Connector [65]**

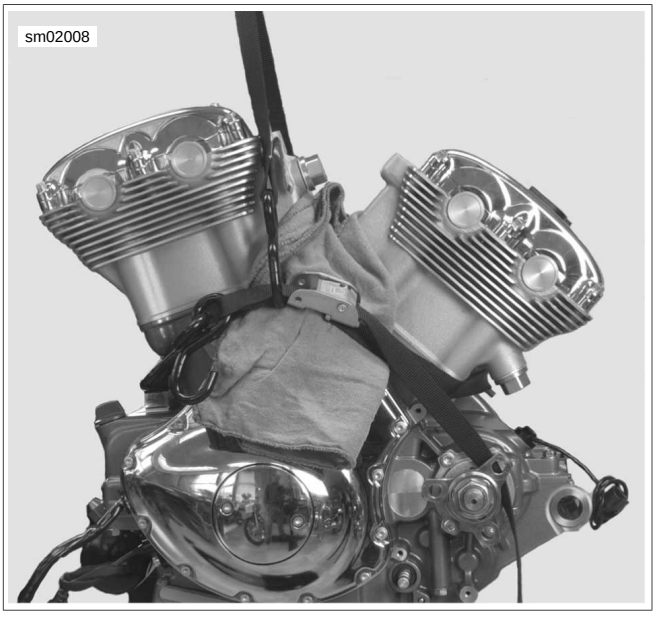



**Figure 2-18. Engine Strapped for Hoisting**

## INSTALLATION

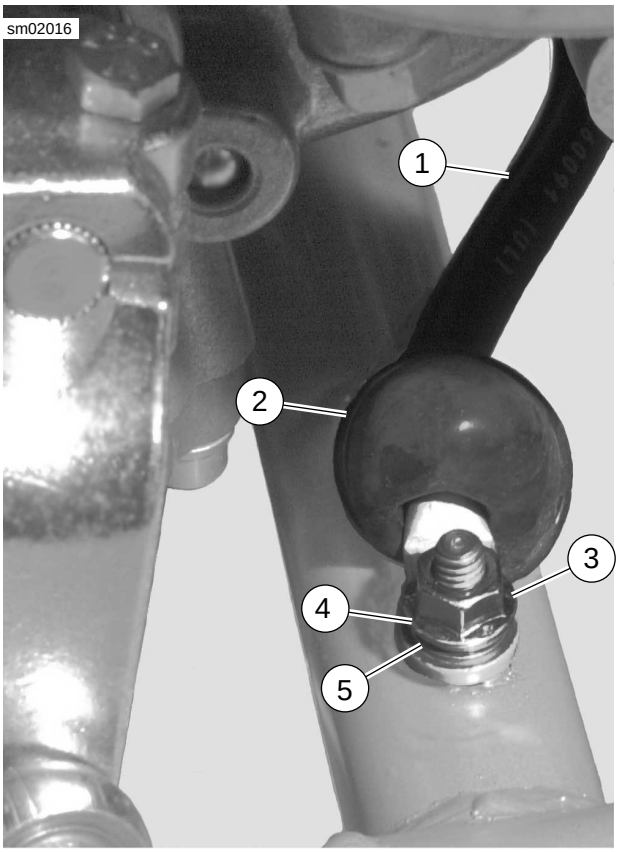
| PART NUMBER | TOOL NAME |
|---|---|
| HD-45317 | ENGINE ASSEMBLY SUPPORT FIXTURE |

1. Verify VIN of replacement engine.
2. Check replacement/overhauled engine for:
   a. Vehicle speed sensor and wiring.
   b. Neutral sending switch.
   c. Ground cable.
3. Verify that engine wiring harness is connected to:
   a. Manifold air pressure sensor [80].
   b. Intake air temperature sensor [89].
   c. Coolant temperature sensor [90].
   d. Oil pressure sending unit [120].
   e. Injector connectors [84, 85].
4. Check oil filter tightness. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
5. Install rear engine mount in left side frame weldment. Pull engine partially into frame capturing left rear engine mount.

*NOTE*

*The left swingarm pivot shaft spacer is inserted into the engine mount. Verify that the pivot shaft spacer is in position before installing the pivot shaft.*

6. With engine oil pan screw detents resting on hex socket-head bolts of the ENGINE ASSEMBLY SUPPORT FIXTURE (Part No. HD-45317) , pull engine into frame with fixture handles.
7. Thread stoplamp electrical wires and connectors and purge solenoid hose (California models only) through cavity in engine cases.
8. See Figure 2-16. Push on stoplamp switch wires.
9. Push purge solenoid hose onto charcoal canister (California models only).
10. See Figure 2-19. Fasten ground cable (1) terminal ring (4) with washer (5) to frame. Tighten to 6-10 Nm (53-88 **in-lbs**) and reinstall rubber boot.
11. See Figure 2-14. Push on neutral light sender wires.
12. See Figure 2-17. Thread vehicle speed sender connector [65] wire up through frame and connect to wiring harness.
13. Install rear engine mounting bracket and engine mount to right side frame weldment. Thread mounting bolts with narrow washers through bracket into frame bosses.




1. **Ground cable**
2. **Boot (pulled back from nut)**
3. **Nut**
4. **Terminal ring**
5. **Washer**

**Figure 2-19. Ground Cable Installation**

14. Raise or lower frame with scissor jack to align pivot shaft bores of swingarm to rear engine mounts and engine case mounting bosses. Apply LOCTITE® ANTI-SEIZE and slide in Swingarm pivot shaft.
15. Apply LOCTITE® 243 (blue) to threads of pivot shaft nut.
16. Install upper engine mounting bracket to engine with fasteners and engine mounting bracket to frame with double threaded studs.
17. Install left frame rail with stabilizer link.
18. Assemble spacer and stabilizer link and thread into crankcase.
19. Tighten fasteners in following order:
   a. Pivot shaft nut to 61-75 Nm (45-55 ft-lbs).
   b. Rear engine mount bracket fasteners (including stabilizer link fasteners) to 34-41 Nm (25-30 ft-lbs).
   c. Front engine mount fasteners to 34-41 Nm (25-30 ft-lbs) .
   d. Lower frame rail fasteners to 61-75 Nm (45-55 ft-lbs) .
   e. Engine crankcase end of stabilizer link to 34-41 Nm (25-30 ft-lbs) .

20. See Figure 2-20. Install shifter arm perpendicular to frame rail for correct operation. Tighten clamp bolt to 14-16 Nm (11-12 ft-lbs) .
21. If removed, attach shifter linkage to shifter arm and tighten to 9-15 Nm (80-132 **in-lbs**) .
22. Install solenoid cable terminal ring to starter post.
23. Tighten solenoid fasteners to the following torques:
    a. Solenoid cable terminal ring to starter post to 6-10 Nm (53-88 **in-lbs**) .
    b. Starter solenoid to frame posts to 6-10 Nm (53-88 **in-lbs**) .
    c. Install secondary clutch actuator onto clutch cover.
24. Install exhaust system. See 4.15 EXHAUST SYSTEM: VRSCDSee 2.36 BELT GUARD AND DEBRIS DEFLECTORSee 1.16 REAR BELT DEFLECTION.
25. Install drive sprocket by matching spokes of drive sprocket to open spaces of mounting flange and rotating sprocket to align sprocket bolt holes behind mounting flange bolt holes.
26. Install and tighten three **new** locking bolts to 88-102 Nm (65-75 ft-lbs) .
27. Route drive belt over wheel sprocket and drive sprocket.
28. If removed, install and belt guard and debris deflector. See 2.36 BELT GUARD AND DEBRIS DEFLECTOR.
29. Adjust drive belt. See 1.16 REAR BELT DEFLECTION.

**⚠WARNING**

**Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)**

30. Tighten axle nut to 190-203 Nm (140-150 ft-lbs) and install snap ring.
31. Install belt drive sprocket cover. Tighten cover fasteners to 6-10 Nm (53-88 **in-lbs**). If necessary, install debris deflector and belt guard.
32. Install engine coolant pipes and hoses. Fasten p-clamp to cylinder head, pipe clamp, and worm drive clamps to both coolant pipe hoses. See 6.6 COOLANT PIPES AND HOSES.

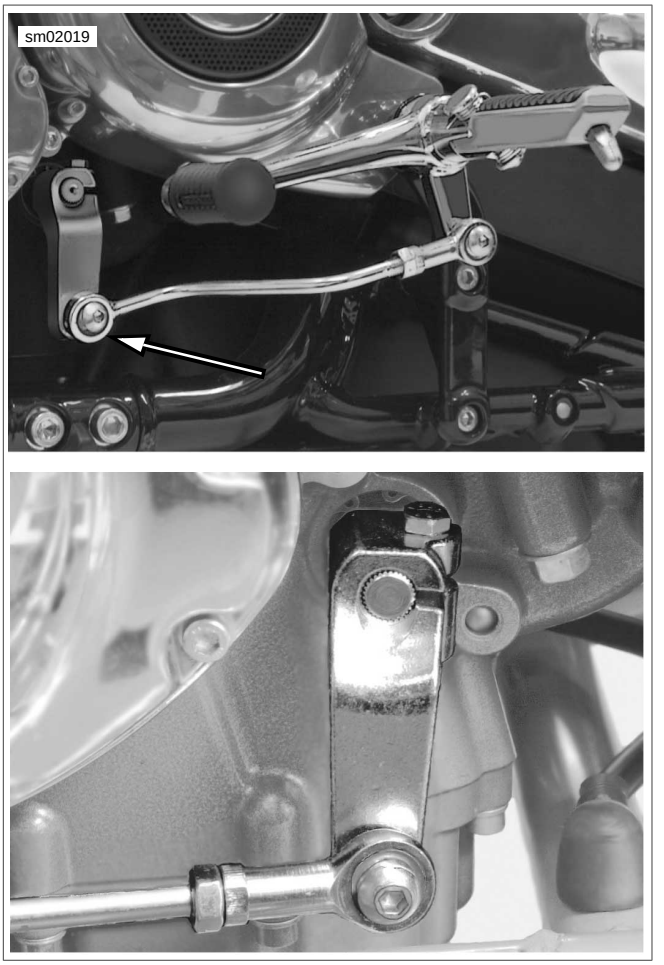



**Figure 2-20. Shifter Arm Perpendicular to Frame Rail (mid-mount controls top, forward-mount controls bottom)**

33. Fit radiator/oil cooler assembly to top mounting studs. Fit coolant out and in hoses to radiator beaded pipes. See 6.8 RADIATOR AND OIL COOLER.
34. Install oil line quick connects to crankcase and oil filter mount oil fittings. See 6.7 OIL LINE FITTINGS.
35. Push radiator/oil cooler assembly mounting pins and grommets into cross member. Thread cross member mounting bolts into frame.

*NOTES*

- *Route hose to remote rear brake reservoir behind brake pedal above the clevis pin before installing cross member. Be sure remote hose is not pinched during installation of radiator/oil cooler assembly and cross member.*
- *Be sure to install all cable straps that were removed during disassembly in their original locations.*

36. Tighten cooling system fasteners:
    a. Cross member fasteners to 20-26 Nm (15-19 ft-lbs).
    b. Top mounting flange nuts to 19-27 Nm (15-20 ft-lbs).
    c. Pipe clamp to 6.5 Nm (57 **in-lbs**).
    d. Pipe connecting clamp to 6-10 Nm (53-88 **in-lbs**).
    e. P-clamp to 6-10 Nm (53-88 **in-lbs**).
    f. Hose worm drive clamps to 3-4 Nm (27-35 **in-lbs**).
    g. Install clutch actuator cover.
37. Route drain hose to overflow bottle.
38. Install radiator cover. See 6.8 RADIATOR AND OIL COOLER.
39. See Figure 2-8. Connect:
    a. Crank position sensor connector [79] (3).
    b. Top and bottom cooling fan connectors [97T] [97B] (2).
    c. Stator to voltage regulator connector [46] (1).
    d. Wiring frame clip (4).
40. Push rear brake fluid reservoir onto radiator cover and install both lower radiator trim covers. See 6.8 RADIATOR AND OIL COOLER.
41. Install throttle body/cables:
    a. For replacement engines: Insert throttle cable barrels into throttle cam, route cable around throttle cam and insert cable housing in cable guides. Adjust cables. See 1.24 THROTTLE CABLES.
    b. For engine overhaul: Install throttle body and tighten clamps to 1.25 Nm (11 **in-lbs**).
42. See Figure 2-8. Connect:
    a. Front (2) and rear coils [83F] [83R].
    b. Main engine harness [45] (7).
    c. Throttle position sensor [88] (4).
    d. Idle speed control actuator [87] (5).
    e. Regulator ground (3).
43. Install horn to rubber grommet and bracket on engine. Connect horn wire to main harness. See 8.21 HORN.
44. Connect GND 2 (9), GND 1 (8) and horn ground wire (10) to rear engine cylinder head.
45. Connect negative battery copper L-bracket and cable to front cylinder head.
46. Install air filter bottom, velocity stacks, o-rings, breather hose, threaded air filter hold down rod, and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
47. Fill engine with oil. See 1.8 ENGINE OIL AND FILTER, Changing Oil and Filter under 1.8 ENGINE OIL AND FILTER.
48. Open radiator air bleed plug and fill cooling system with Genuine Harley-Davidson Extended Life Antifreeze and Coolant through coolant pressure cap. See 6.2 COOLANT FLOW.
49. Tighten radiator air bleed plug to 9-11 Nm (80-97 **in-lbs**).

**⚠WARNING**

**Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)**

50. Connect positive battery cable to battery, cover with boot and then connect negative battery cable to battery. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**) .
51. With the ignition coils disconnected, use the starter to turn the engine over to prime the engine with oil. The engine oil pressure indicator lamp should not illuminate. See 3.5 OIL PRESSURE.
52. Install air filter, air filter top and airbox cover.
53. Close seat.
54. Install maxi-fuse and right side cover.
55. Test ride motorcycle and adjust as required.

## RIDER FOOTRESTS

### Removal

1. With motorcycle in neutral, remove fastener from shift linkage to foot shift lever.
2. See Figure 2-21. Remove retaining ring (1) from clevis pin (3) holding left footrest (2) to left footrest axle (5). Remove clevis, footrest, and spring washer (4).

*NOTE*

*Shift lever toe peg unthreads from shift lever. Remove and replace as required.*

3. Remove fastener (8) holding left footrest axle (5) to frame. Remove left footrest axle (5) and foot shift lever (7).
4. Remove left side radiator cover.
5. Remove the cotter key from the clevis pin connecting rear brake pedal (9) to master cylinder brake rod.
6. Cover outside face of clevis pin with cardboard and using a large pliers, squeeze pin until pin shoulder pops out of interference fit in the clevis. Remove clevis pin and brake rod.
7. Remove retaining ring (1) from clevis pin (3) holding right side footrest (2) to footrest axle (6). Remove clevis, footrest, and spring washer.
8. Remove fastener (8) holding right side footrest axle (6) to frame. Pull footrest axle (6) from frame and rear brake pedal (9).

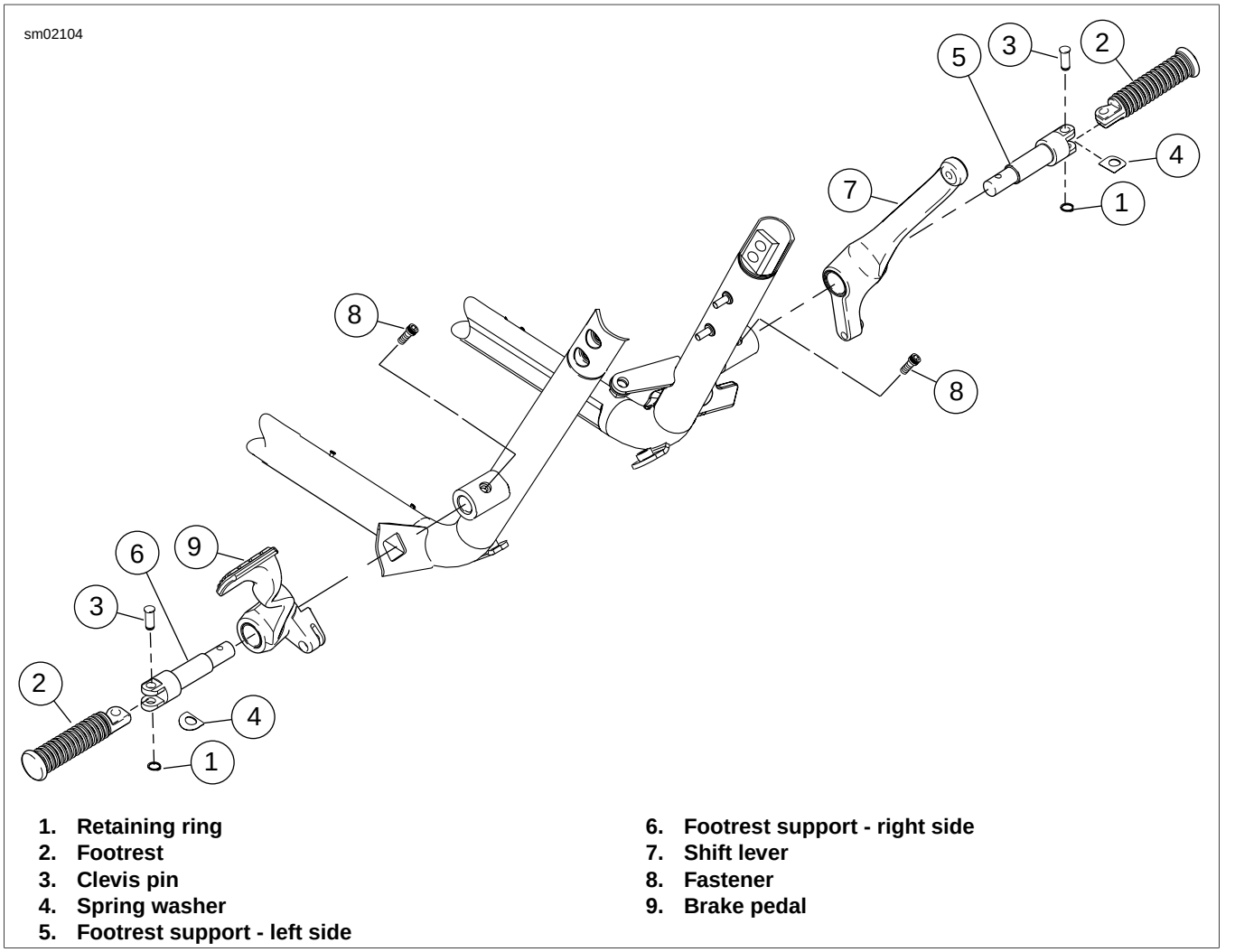
### Installation

1. See Figure 2-21. Install left side footrest axle (5) and foot shift lever (7). Tighten fastener to 11-17 Nm (9-12 ft-lbs).
2. Install fastener holding shift linkage to foot shift lever (7). Tighten to 9-15 Nm (7-11 ft-lbs).

**⚠WARNING**

**Footrests must fold up and toward rear of motorcycle if struck. Failure to set footrests to fold up and back could result in death or serious injury. (00366a)**

3. Orient footrest (2) to fold upwards on contact with ground.
4. Install clevis pin (4) through left side footrest axle (6), footrest (2), and spring washer (4). Secure with a **new** retaining ring (1).
5. Install right side footrest axle (6) through rear brake pedal (9). Using LOCTITE® 243 (blue), thread in and tighten fastener to 11-17 Nm (9-12 ft-lbs).
6. Install clevis pin (3) through right side footrest axle (6), footrest (2), and spring washer (4). Secure with a **new** retaining ring (1).
7. Install clevis pin through rear brake pedal clevis and master cylinder brake rod.
8. Cover the face of clevis pin and clevis with cardboard. Holding the brake pedal (9) firmly, tap on a rod to seat shoulder of clevis pin into clevis. Install new cotter pin.



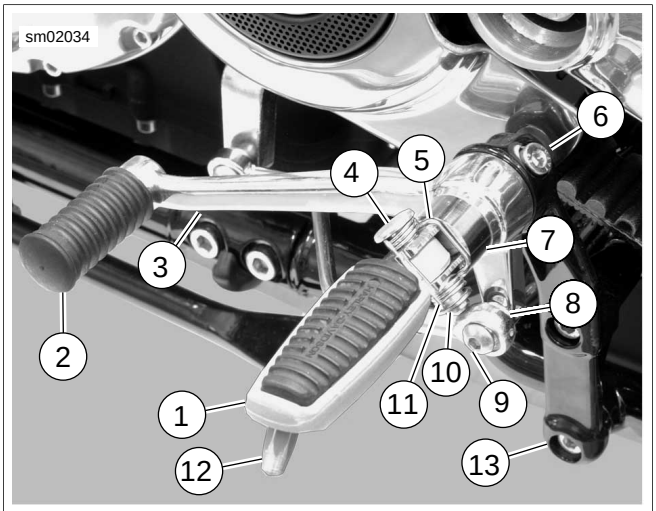

1. **Retaining ring**
2. **Footrest**
3. **Clevis pin**
4. **Spring washer**
5. **Footrest support - left side**
6. **Footrest support - right side**
7. **Shift lever**
8. **Fastener**
9. **Brake pedal**

**Figure 2-21. Rider Footrests (All With Forward Mounted Controls)**

## RIDER FOOTRESTS

### Rider Left Side Footrest and Control Removal

1. Remove maxi-fuse and place motorcycle in neutral.




1. **Footrest**
2. **Shift level toe peg**
3. **Shift lever**
4. **Clevis pin**
5. **Spring**
6. **Capscrew**
7. **Footrest bracket**
8. **Shift linkage**
9. **Capscrew**
10. **Retaining ring**
11. **Washer**
12. **Wear peg**
13. **Frame bracket**

**Figure 2-22. Left Footrest and Control Assembly (typical)**

2. See Figure 2-22. To remove left side footrest (1), remove retaining clip (10), washer (11), clevis pin (4) and remove footrest from footrest bracket (7).

*NOTES*

- *Shift lever toe peg unthreads from shift lever. Remove and replace as required.*
- *Do not disturb the adjustment on the shift linkage during disassembly or assembly to ensure proper shifting.*
- *Wear peg unthreads from end of footrest. Remove and replace as required.*

3. To remove footrest and control as a unit, remove capscrew (9), disconnect shift linkage (8), remove capscrew (6) and remove footrest/control assembly from motorcycle.

### Rider Left Side Footrest and Control Installation

1. See Figure 2-22. To install left side footrest, (1), insert footrest into footrest bracket (7), insert clevis pin (4), install washer (11), spring (5), and **new** retaining clip (10).
2. To install footrest and control as a unit, insert footrest/control assembly into frame bracket (13) apply LOCTITE® 243 BLUE and install capscrew (6) tighten to 30-35 Nm (22-26 ft-lbs).
3. Attach shift linkage (8) to shift lever (3), apply LOCTITE® 243 BLUE and install capscrew (9). Tighten to 9-15 Nm (7-11 ft-lbs).

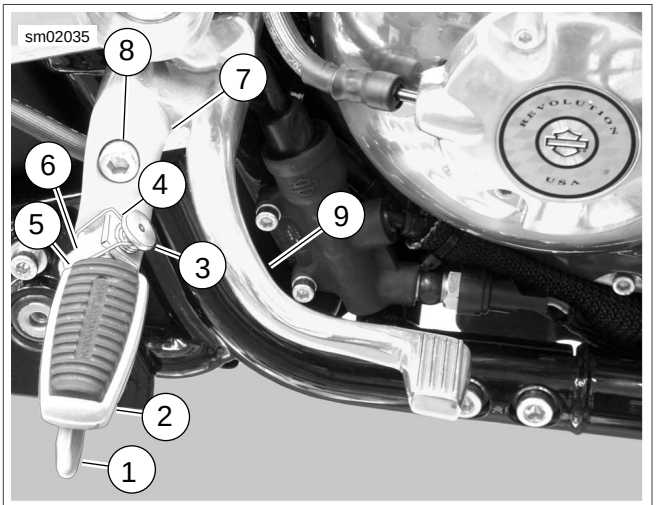
**⚠WARNING**

**Footrests must fold up and toward rear of motorcycle if struck. Failure to set footrests to fold up and back could result in death or serious injury. (00366a)**

4. Verify footpeg function.
5. Verify shifting.
6. Install maxi-fuse.

### Rider Right Side Footrest and Control Removal

1. Remove maxi-fuse and place motorcycle in neutral.




1. **Wear peg**
2. **Foootpeg**
3. **Clevis pin**
4. **Spring**
5. **Retaining clip**
6. **Washer**
7. **Footrest bracket**
8. **Capscrew**
9. **Brake pedal**

**Figure 2-23. Right Footrest and Control Assembly**

1. See Figure 2-23. To remove right side footrest, remove retaining clip (5), washer (6), clevis pin (3) and spring (4). Pull footrest (2) from footrest bracket (7).

*NOTE*

*Wear peg unthreads from end of footrest. Remove and replace as required.*

2. See Figure 2-24. Remove master cylinder brake pedal clip
3. See Figure 2-23. Remove footrest and control as a unit by removing capscrew (8) from footrest bracket (7).
4. Slowly pull footrest/control assembly away from motorcycle working master cylinder rod free from brake pedal (9).

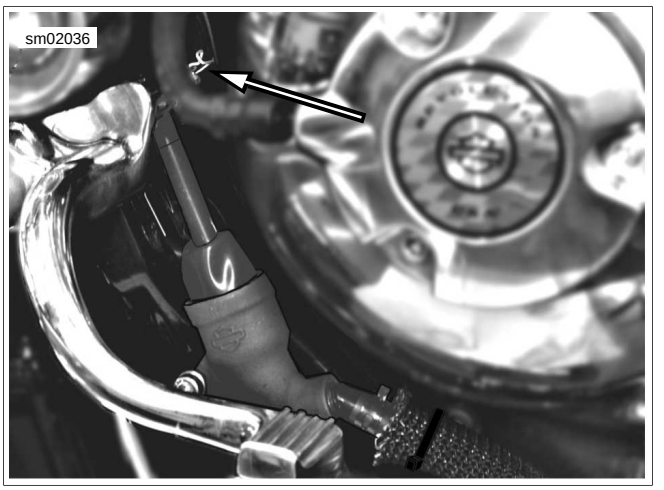



**Figure 2-24. Master Cylinder Brake Pedal Clip**

## Rider Right Side Footrest and Control Installation

1. See Figure 2-23. To install right side footrest, (2), insert footrest into footrest bracket (7), insert clevis pin (3), install washer (6), spring (4) and **new** retaining clip (5).
2. To install footrest and control as a unit, position brake pedal (9) to motorcycle and insert master cylinder rod into brake pedal.
3. See Figure 2-24. Install master cylinder brake pedal clip.

*NOTE*

*Make sure master cylinder brake clip is completely seated.*

4. See Figure 2-23. Install footrest assembly with footrest bracket (7) to motorcycle. Apply LOCTITE® 243 BLUE and install capscrew (8). Tighten to 34-41 Nm (25-30 ft-lbs).

**⚠WARNING**

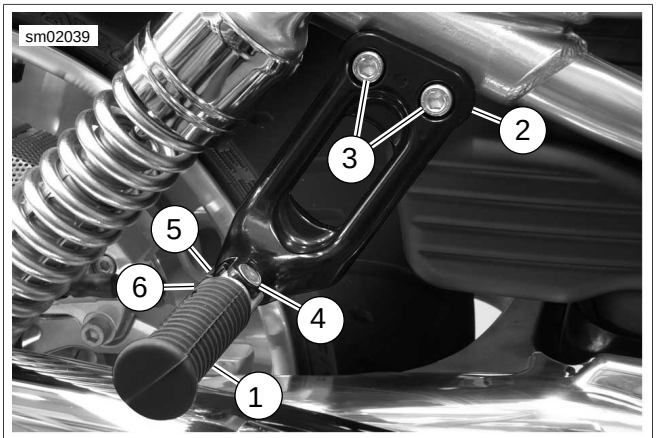
**Footrests must fold up and toward rear of motorcycle if struck. Failure to set footrests to fold up and back could result in death or serious injury. (00366a)**

5. Verify footpeg function.
6. Verify brake pedal function.
7. Install maxi-fuse.

## PASSENGER FOOTRESTS

### Removal

1. See Figure 2-25. Remove retaining clip (6) and spring washer (5) from clevis pin (4). holding footrest (1). Remove clevis pin, and footrest from footrest bracket (2).
2. Remove two socket head capscrews (3) from footrest bracket (2). Remove footrest bracket.
3. Repeat for opposite side passenger footrest assembly.




1. **Footrest**
2. **Footrest bracket**
3. **Socket head capscrews (2)**
4. **Clevis pin**
5. **Spring washer**
6. **Retaining clip**

**Figure 2-25. Passenger Footrests**

### Installation

1. See Figure 2-25. Mount the footrest bracket (2) to frame. Install and tighten socket head capscrews (3) to 19-27 Nm (14-20 ft-lbs).
2. Install footrest (1) to footrest bracket and hold in upward position.
3. Install clevis pin (4) through footrest bracket (2), install spring washer (5) and secure with a **new** retaining ring (6).
4. Repeat for opposite side.

## REMOVAL/DISASSEMBLY

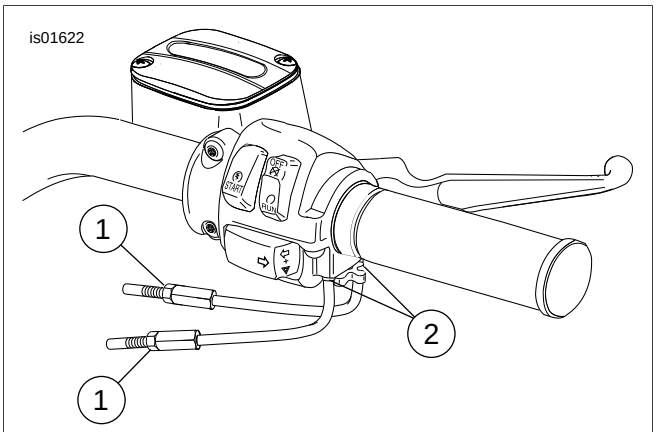
1. See Figure 2-26. Loosen cable adjuster jam nuts (1). Screw throttle cable adjuster until it is as short as possible.
2. Remove screws that hold handlebar housing together to separate the upper and lower housings.
3. Use a screwdriver to rotate cable ferrules in throttle grip notches. Remove cables from notches on inboard side of throttle grip and remove cables from throttle grip and lower housing.
4. Remove airbox. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
5. Remove throttle cable housings from guides at throttle body and remove cable barrels from throttle cam.
6. See Figure 2-27. Pull cables from housing by placing a drop of oil on retaining ring that holds cable in housing, then firmly pull bent tubing portion of cable out of housing using a rocking motion.

## CLEANING AND INSPECTION

**⚠ WARNING**

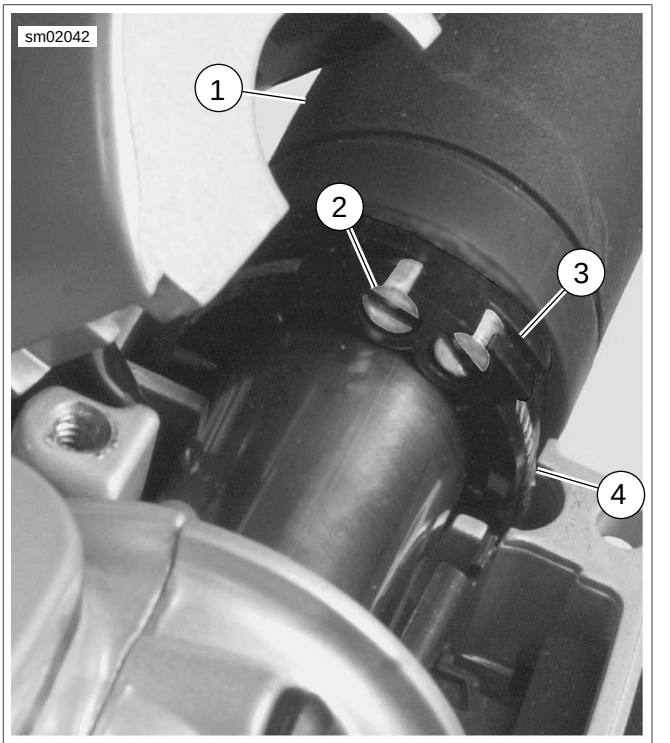
**Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)**

1. Wash all components in non-flammable cleaning solvent. Blow parts dry with low pressure compressed air.
2. Replace control cables if frayed, kinked or bent.
3. Put one or two drops of oil into housing of each cable.




**1. Adjuster jam nut (2)**
**2. Insert (2)**

**Figure 2-26. Handlebar Throttle Control**




**1. Throttle grip**
**2. Ferrule**
**3. Groove**
**4. Idle cable (gold insert, rear hole)**

**Figure 2-27. Throttle Cable Attachment (typical)**

## ASSEMBLY AND INSTALLATION

1. Apply a light coating of graphite to handlebar and inside surface of housings.
2. See Figure 2-27. Attach control cable assemblies to lower housing.
   a. Push silver insert of the cable housing into hole in front of tension adjuster screw. Snap in retaining ring.
   b. Push gold insert of idle cable housing into hole at rear of tension adjuster screw. Snap in retaining ring.
   c. Install adjusting screw, spring and friction pad in lower housing if they were removed.
3. Position throttle grip on the handlebar. Place lower housing on throttle grip.
4. Fit ferrules (2) over cable balls. Slide ferrules into throttle notches and rotate so cables fit grooves (3) in throttle grip.
5. Fasten upper housing to lower housing using two screws. Tighten to 4-5 Nm (35-45 **in-lbs**).
6. Route throttle cables through right side hole in upper fork clamp and behind radiator cover along side battery.

**⚠WARNING**

**Never route throttle cable over the battery. Fire due to short circuit could occur and cause death or serious injury. (00494c)**

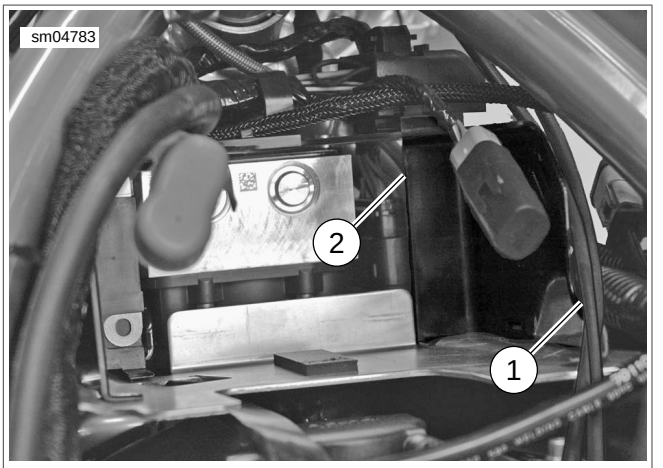
7. Insert throttle cable barrels on throttle cam and fit cables into guides.

**⚠WARNING**

**Do not tighten throttle friction adjustment screw to the point where the engine will not return to idle automatically. Over-tightening can lead to loss of vehicle control, which could result in death or serious injury. (00031b)**

8. Adjust cables for correct throttle opening and closing. See 1.24 THROTTLE CABLES.

9. Install airbox. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.




1. **Throttle cables**
2. **Right side battery caddy**

**Figure 2-28. Throttle Cable Routing**

## GENERAL

The clutch is hydraulically actuated. Squeezing the clutch hand lever causes the clutch master cylinder to apply pressure via the clutch fluid in the clutch line to the secondary clutch actuator mounted to the engine right side cover. The secondary clutch actuator piston extends and contacts the clutch release bearing which disengages the clutch.

A bleeder screw at the secondary clutch actuator allows bleeding air from the clutch lines. D.O.T. 4 BRAKE FLUID is used in the clutch system.

Check the clutch fluid level in the clutch fluid reservoir on left handlebar. If the sight gauge is dark, the fluid level in the reservoir is above the sight gauge prism and the reservoir is full. If the sight gauge appears clear, the fluid level is below the sight gauge prism and the fluid level should be checked. Fluid level should be level with the internal shelf marked FILL LEVEL with the motorcycle upright.

**CAUTION**

**D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)**

## REMOVAL

1. While holding turn signal locknut underneath clutch lever/master cylinder assembly, unthread mirror (counter-clockwise). Remove mirror and turn signal.
2. Remove electrical controls.

*NOTE*

*To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.*

3. See Figure 2-29. Loosen, but do not remove, screws (10) with flat washers (9) that detach handlebar clamp (8) from clutch master cylinder/reservoir.
4. Loosen both screws (3) on cover (1) to relieve pressure in master cylinder reservoir.

**⚠WARNING**

**Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)**

*NOTES*

- *Place a large cup under the banjo fitting. Hydraulic fluid will begin draining from the reservoir as the banjo bolt is removed.*
- *Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing clutch line components.*

5. Slowly loosen banjo bolt (6) and allow clutch fluid from reservoir to drain into cup.

*NOTE*

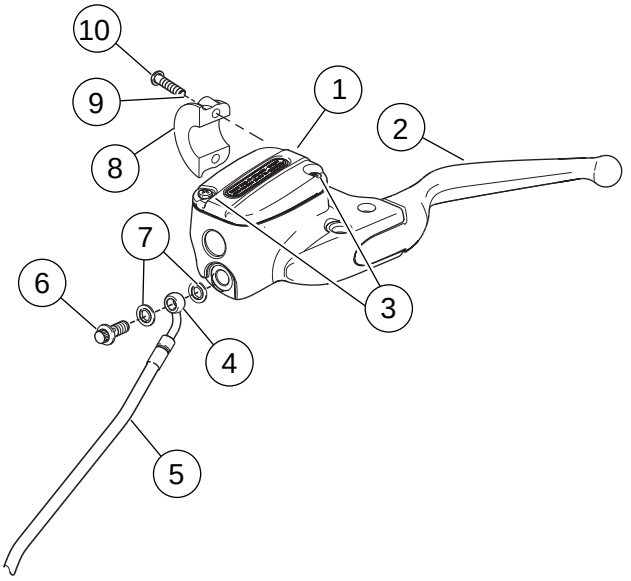
*Dispose of clutch fluid in accordance with local regulations.*

6. Remove banjo bolt (6) and two copper washers (7) to disconnect fitting of hydraulic clutch fluid line (5) from clutch reservoir and master cylinder. Discard copper washers.

*NOTE*

*To prevent the rest of the clutch fluid from draining from the clutch line and secondary clutch actuator, support the banjo fitting and clutch fluid line upright. Plug the banjo bolt hole with a finger to transfer the assembly to a workbench without spilling clutch fluid.*

7. Remove handlebar clamp screws and take clamp and clutch master cylinder/reservoir assembly to a workbench.




1. **Cover**
2. **Clutch hand lever**
3. **Cover hold down screws**
4. **Banjo fitting**
5. **Clutch fluid line**
6. **Banjo bolt**
7. **Copper washers**
8. **Handlebar clamp**
9. **Washer**
10. **Clamp screw**

**Figure 2-29. Clutch Master Cylinder/Reservoir**

## DISASSEMBLY

*NOTE*

*To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.*

1. Drain additional clutch fluid from master cylinder/reservoir.
2. Remove screws securing master cylinder cover. Remove cover and gasket. Turn housing upside down to remove remaining clutch fluid from reservoir.

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

3. Remove retaining ring from pivot pin groove.

*NOTE*

*To take the piston spring load off the pin and remove the pivot pin, gently force the clutch lever toward the piston (as if operating the clutch).*

4. Remove pivot pin through top of housing. Remove and save pivot pin and clutch lever.
5. See Figure 2-30. Using a toothpick or small screwdriver, gently pry outer edge of piston boot (1) out of piston bore.
6. Remove piston (2) and spring (4).

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)**

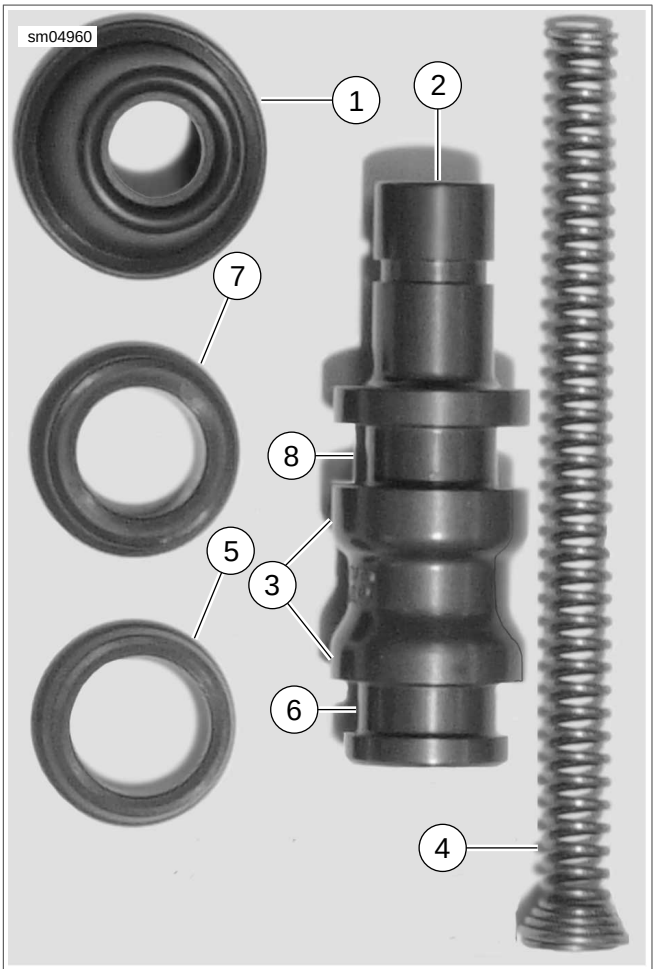
**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

*NOTE*

*Do not use a wire or sharp instrument to clean drilled oil passages.*

7. Inspect cylinder housing bore for scoring, pitting or corrosion. Also check outlet port for damage. Replace housing if necessary.
8. Inspect the cover, sight glass, and gasket for cuts, tears or general deterioration.




1. **Boot**
2. **Piston**
3. **Shoulder**
4. **Spring**
5. **Primary cup**
6. **Groove - primary cup**
7. **Secondary cup**
8. **Groove - secondary cup**

**Figure 2-30. Clutch Master Cylinder Components**

## ASSEMBLY

To rebuild clutch master cylinder, use the components found in the service parts kit.

1. See Figure 2-30. Lightly lubricate inside of primary cup (5) and fit over lip on spring end of piston (2) so the closed end (small ID) contacts evenly with the shoulder (3) in primary cup grove (6).
2. Lightly lubricate inside of secondary cup (7) (steep taper from center to outside diameter) and fit over the lip on outboard end of piston (2) so that flared end is open toward the shoulder (3) of the secondary cup groove (8).
3. Install boot (1), large sealing ID first, on piston (2) until seal on smaller ID fits snugly into thin groove in piston.

*NOTE*

*See Figure 2-30. The flared ends of the primary cup and the secondary cup face the spring end of the piston.*

4. Using lubricant in service parts kit, thoroughly coat outside diameters of primary and secondary cups. Coat master cylinder piston bore.
5. See Figure 2-30. With tapered end out, install spring (4) into opening on inboard side of piston assembly.
6. Align and install piston assembly into bore. Firmly press on flat end of piston, compressing spring, until the entire assembly slides into cylinder bore.

*NOTE*

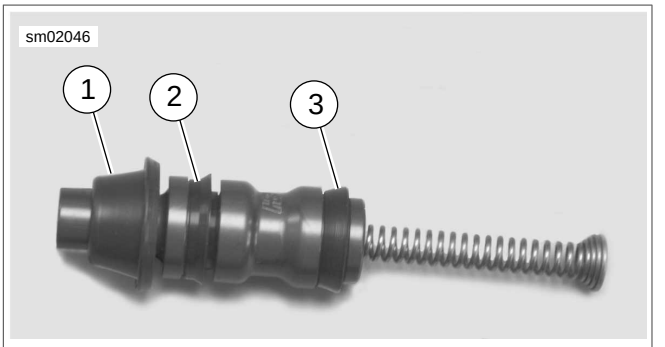
*When fitting the piston sealing boot, be careful not to tear, perforate or damage the piston sealing boot.*

7. Compress piston until it is even with the end of bore. Using a small dull bladed screwdriver or similar tool, gently work around sealing edges of boot until entire circumference of boot is seated in cylinder bore groove.
8. If cover gasket and/or sight glass replacement is necessary. Proceed as follows:
   a. From inboard side, push sight glass toward top of cover until free.
   b. Pull rubber gasket from cover.
   c. Fit nipple of **new** gasket into hole of cover aligning gasket and cover thru holes.
   d. From bottom of gasket, push flat end of sight glass through nipple until top of glass is flush with top of gasket. Verify that glass is square in bore. If lubrication is necessary, use clean D.O.T. 4 BRAKE FLUID.
9. Install cover with gasket on master cylinder reservoir. Install two screws to fasten the cover to reservoir, but do not tighten.

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

10. To install existing clutch hand lever, install clutch hand lever, pivot pin, and a **new** retaining ring.
11. To install a replacement clutch hand lever, See 2.13 CLUTCH HAND LEVER.




1. **Boot in piston groove**
2. **Secondary cup flare**
3. **Primary cup**

**Figure 2-31. Assembled Cups and Piston**

## INSTALLATION

1. See Figure 2-29. Attach master cylinder/reservoir to handlebars with handlebar clamp (8). Orient lever to rider position and tighten two clamp screws (10) to 8-9 Nm (71-80 **in-lbs**).
2. Attach banjo fitting (4) of clutch fluid line to master cylinder with **new** copper washers. Install electrical controls.
3. Remove secondary clutch actuator cover and loosen bleeder screw.
4. Fill reservoir with D.O.T. 4 BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder screw. Finger tighten bleed screw.
5. Bleed clutch line. See 1.15 BLEEDING CLUTCH FLUID LINE.
6. Verify that fluid level in clutch fluid reservoir is at FILL LEVEL with motorcycle upright.

*NOTE*

*Clutch fluid volume increases with clutch wear. Do not overfill clutch reservoir.*

7. Verify pressure by squeezing clutch hand lever.
8. Tighten fasteners as follows:
   a. Banjo bolt (6) to 17-20 Nm (13-14 ft-lbs).
   b. Bleeder screw to 9-11 Nm (80-97 **in-lbs**).
   c. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
   d. Secondary clutch actuator cover mounting bolts to 6-10 Nm (53-88 **in-lbs**).

**⚠WARNING**

**Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)**

9. Install rear view mirror and turn signals.
10. Test ride motorcycle.

## REMOVAL

1. Remove retaining ring from pivot pin.
2. Remove pivot pin.
3. Slide lever free from clutch master cylinder housing.

## INSTALLATION

1. See Figure 2-32. Slide bushing cups (3) onto pins of roller with cup flanges against roller.

*NOTE*

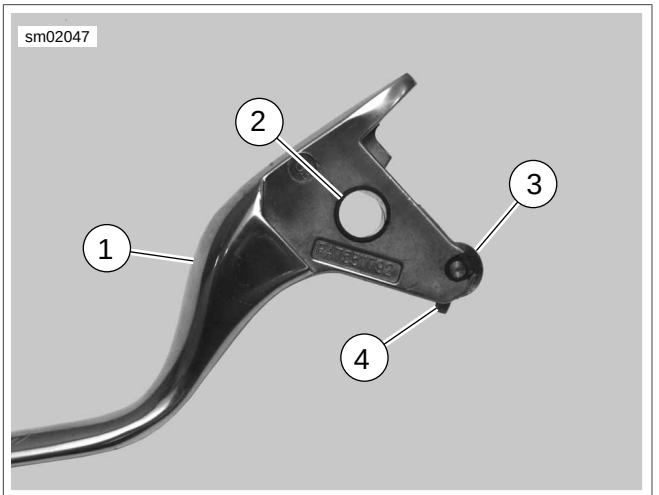
*Be careful when handling the busing cups. The bushing cups are hard plastic and can be easily broken.*

2. With connector bow (3) portion of the bushing cups parallel with groove in clutch handle, snap roller pin (4) with the busing cups installed into clutch lever roller groove. If bushing is positioned correctly, roller/bushing assembly will install with a snap and will be held securely.
3. Lightly grease pivot bushing (2) and install into clutch hand lever (1) pivot hole. Position bushing until it is flush with both sides of lever.

*NOTE*

*If the clutch master cylinder/reservoir is full of clutch fluid under pressure, it may be necessary to apply force to the hydraulic piston (in the clutch hand lever mount) in order to align the clutch hand lever and to allow the pivot pin to be inserted.*

4. Orient clutch lever in lever mounting bracket. Insert pivot pin from top and tap into place.
5. Install retaining ring on pivot pin.




1. **Clutch hand lever**
2. **Pivot bushing installed**
3. **Bushing cups connector bow**
4. **Roller pin**

**Figure 2-32. Clutch Hand Lever**

## REMOVAL

Inspect the clutch fluid line for wear, damage, and leaks. Replace if necessary.

1. Remove secondary clutch actuator cover from left side clutch cover.

**⚠WARNING**

**Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)**

2. Place a suitable container under secondary clutch actuator. Loosen flare nut and allow clutch fluid to drain from clutch line.

*NOTE*

*Dispose of clutch fluid in accordance with local regulations.*

3. Remove banjo bolt and two copper washers to disconnect fitting of hydraulic clutch fluid line from clutch reservoir and master cylinder. Discard washers.
4. See Figure 2-33. Remove clutch fluid line from clips on frame.

*NOTE*

*Note locations and number of cable straps used prior to disassembly.*

5. Carefully thread banjo fitting end of clutch line out through upper triple clamp. Thread flare nut end of clutch line out through bottom of motorcycle and remove clutch line through front down tubes.

## INSTALLATION

1. Route clutch line banjo fitting up through upper triple clamp, then route line behind steering head over to right frame rail and along inside of rail under engine and back up between bottom frame rails to loop out and forward to secondary clutch actuator mounted on clutch cover.
2. Thread in and finger tighten flare nut fastening clutch fluid line to secondary clutch actuator.
3. Attach banjo fitting of the clutch fluid line to master cylinder with **new** copper washers.
4. Install all cable straps and ties that were removed during disassembly in their original locations.

**⚠WARNING**

**Be sure no clutch fluid gets on tires, wheels or brakes when adding fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00294a)**

**CAUTION**

**Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)**

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

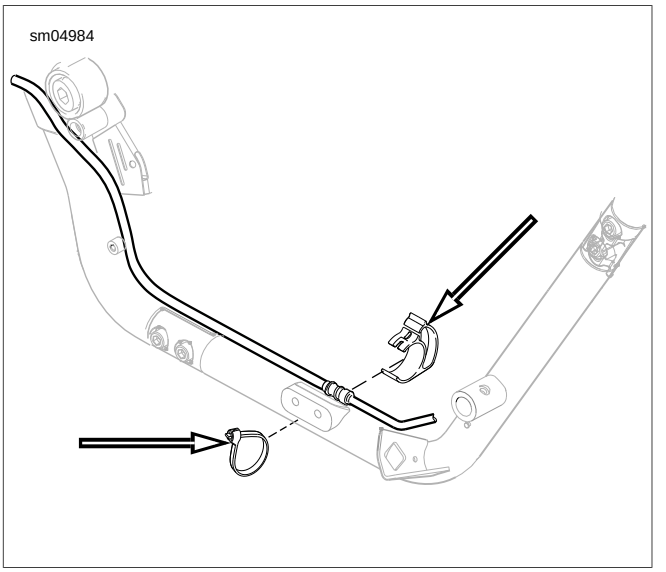



**Figure 2-33. Clutch fluid line clips and ties**

## REMOVAL

1. Remove secondary clutch actuator cover.
2. See Figure 2-34. Remove mounting bolts (2) holding secondary clutch actuator (4) to clutch cover.

*NOTE*

*The piston in the secondary clutch actuator is under pressure. Squeezing the clutch hand lever could push the piston out of its housing requiring the clutch actuator to be rebuilt.*

3. See Figure 2-35. Inspect o-ring (2). Replace if necessary and re-install actuator.

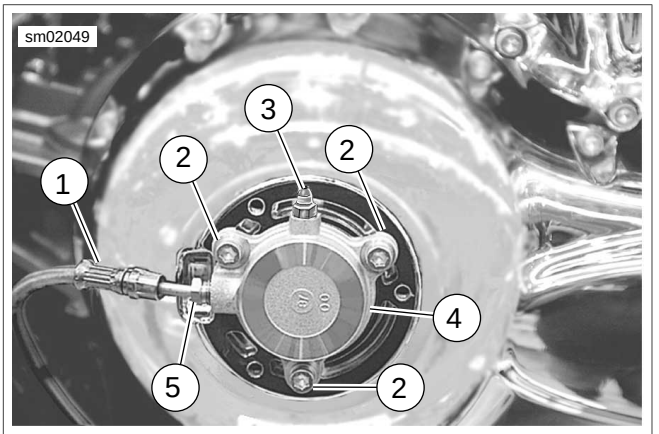
*NOTE*

*Dispose of clutch fluid in accordance with local regulations.*

4. See Figure 2-34. If condition indicates replacement of secondary actuator:
   a. Place a suitable container under secondary clutch actuator (4). Loosen flare nut (5) and allow clutch fluid to drain from clutch line (1).
   b. Remove flare nut and remove actuator.
   c. Remove bleeder screw and drain remaining clutch fluid.

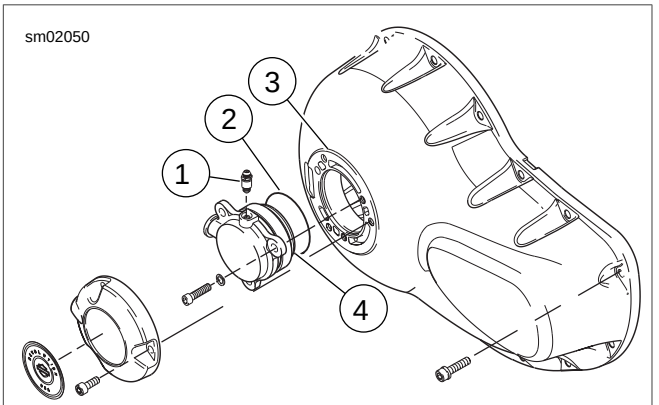
## ASSEMBLY

1. See Figure 2-36. Coat cylinder bore, piston, O-ring, boot, and bleeder screw with lubricant from service kit.
2. Orient a **new** seal (5) with square split lip toward rider side of actuator and fit to piston (6).
3. Insert spring into cylinder bore and insert piston into cylinder bore. Compress and guide seal lip as piston is pressed into bore.
4. Install a **new** O-ring (3) into groove at base of secondary clutch actuator housing (1).
5. Fit boot (7) to piston (6) and push edge of boot over machined lip around housing (1).
6. Fit **new** O-ring (3) to bleeder screw (2) and loosely install into housing.




1. **Clutch fluid line**
2. **Mounting bolts**
3. **Bleeder screw**
4. **Secondary clutch actuator**
5. **Flare nut**

**Figure 2-34. Secondary Clutch Actuator Installed**




1. **Bleeder screw**
2. **O-ring**
3. **Clutch release bearing**
4. **Secondary clutch actuator piston**

**Figure 2-35. Secondary Clutch Actuator**

## INSTALLATION

1. Install clutch fluid line flare nut to secondary clutch actuator. Tighten to 9-13 Nm (80-115 **in-lbs**).
2. Loosen bleeder screw.

**⚠WARNING**

**Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)**

**CAUTION**

**Do not allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205c)**

*NOTE*

*The piston in the secondary clutch actuator is under pressure. Squeezing the clutch hand lever could push the piston out of its housing requiring the clutch actuator to be rebuilt.*

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

3. Fill reservoir with D.O.T. 4 BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder screw. Tighten bleeder screw.

*NOTE*

*When filling an empty clutch fluid line, a Snap-on Basic Vacuum Brake Bleeder with a fitting that mates to the bleeder screw threads can be used to initially draw the fluid down the clutch line with little or no air in the line.*

4. Bleed clutch fluid line. See 1.15 BLEEDING CLUTCH FLUID LINE.

5. Tighten fasteners as follows:
   a. Banjo bolt to 23-31 Nm (17-23 ft-lbs).
   b. Bleeder screw to 9-11 Nm (80-100 **in-lbs**).
   c. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).

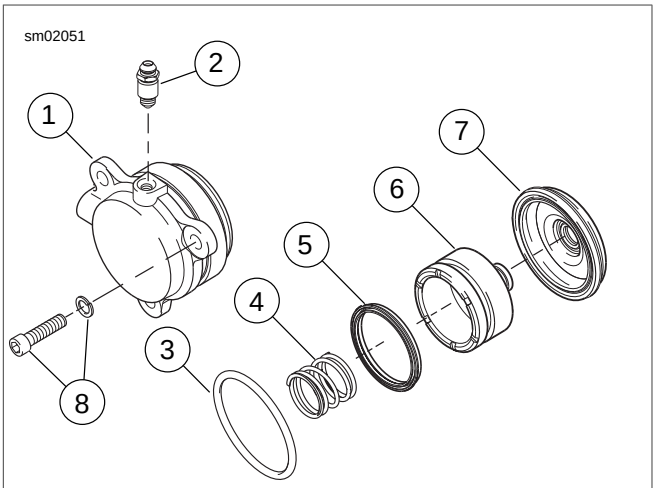
6. Determine sufficient piston travel.

*NOTE*

*Insufficient piston travel may indicate a fluid or pressure leak somewhere in the actuator, clutch fluid line, or clutch master cylinder.*

7. Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (88 **in-lbs**).

8. Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-88 **in-lbs**).




1. **Secondary clutch actuator housing**
2. **Bleeder screw**
3. **O-ring**
4. **Spring**
5. **Seal**
6. **Piston**
7. **Boot**
8. **Mounting bolts and washers**

**Figure 2-36. Secondary Clutch Actuator Components**

## GENERAL

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

## REMOVAL AND DISASSEMBLY

*NOTE*

*Master cylinders designed for dual disc (two caliper) operation have an 15 mm (19/32 in.) bore.*

1. Open bleeder nipple caps on front brake calipers. Install clear plastic tubing over each caliper bleeder valve, while placing free ends in a suitable container. Open bleeder valves about 3/4-turn. Pump brake hand lever to drain brake fluid from reservoir. Close bleeder valve. See 1.12 BLEEDING BRAKES.

**CAUTION**

**Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)**

2. Remove banjo bolt and two copper washers to disconnect fitting of hydraulic brake line from front brake master cylinder. Discard washers.

**CAUTION**

**Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)**

3. See Figure 2-37. Place cardboard insert (2) between brake lever and reservoir housing.

4. See Figure 2-38. Remove screw (21) to detach handlebar clamp (20) from master cylinder reservoir (6).

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

5. Remove retaining clip (10) from pivot pin (7) and remove brake hand lever (9) from master cylinder.

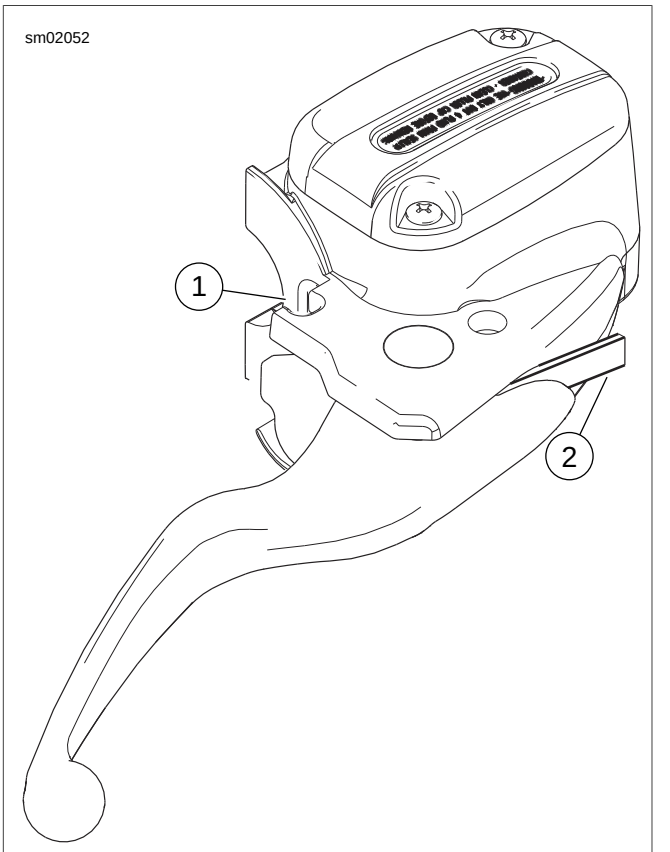
6. Remove push rod (19), dust cover (18) and retainer clip (17).

7. Remove piston (15) and spring (11) from master cylinder bore.

*NOTE*

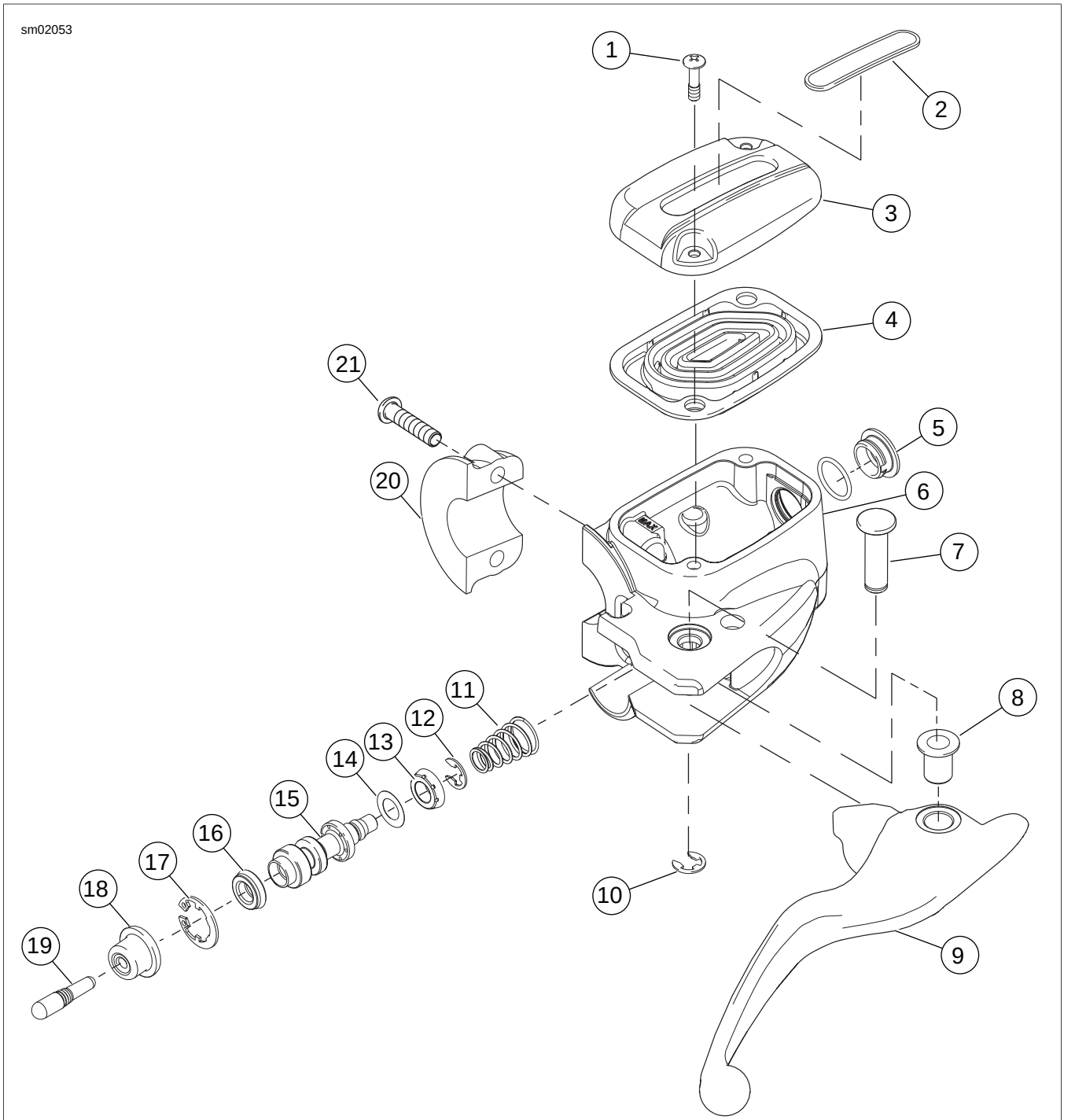
*To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.*

8. Remove both screws (1), cover (3) and cover gasket (4).




**1. Groove**
**2. 4 mm (5/32 in.) thick cardboard insert**

**Figure 2-37. Front Brake Master Cylinder and Reservoir**




1. Screw (2)
2. Label (D.O.T. 4)
3. Cover
4. Gasket
5. Sight glass and retaining clip
6. Master cylinder reservoir
7. Pivot pin
8. Bushing
9. Brake hand lever
10. Retaining clip
11. Spring
12. Retaining clip
13. Primary seal
14. Washer
15. Piston
16. Secondary seal
17. Retaining clip
18. Dust cover
19. Push rod
20. Handlebar clamp
21. Screw

**Figure 2-38. Front Brake Master Cylinder**

## CLEANING AND INSPECTION

1. Always assemble master cylinder using **new** parts from repair kit.

**⚠WARNING**

**Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)**

2. Clean all parts with denatured alcohol or D.O.T. 4 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe dry with a clean, lint free cloth.

**⚠WARNING**

**Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)**

3. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages in bottom of reservoir.
4. Carefully inspect all parts for wear or damage and replace as necessary.
5. Inspect piston bore in master cylinder housing for scoring, pitting or corrosion. Replace master cylinder if any of these conditions are found.
6. Inspect outlet port that mates with brake line fitting. If any scratches, dents or other damage is found on this critical sealing surface, replace housing.
7. Inspect cover, sight glass and gasket for cuts, tears or general deterioration. If gasket and/or sight glass replacement is necessary, proceed as follows:
   a. From inboard side, push sight glass (5) out of casting.
   b. Pull rubber gasket (4) from cover (3).

*NOTE*

*Cover gasket is unidirectional and will only fit properly one way. Verify correct installation before completing assembly.*

   c. Fit **new** gasket into cover, aligning gasket and cover thru holes.

## ASSEMBLY

To rebuild front brake master cylinder, use the components found in the Service Parts Kit.

1. Install **new** front master cylinder kit. Kit includes: primary seal, secondary seal, piston valve, and spring as an assembly.

*NOTE*

*Apply a drop of grease (supplied with brake kit) to each end of push rod before installation. DO NOT use this grease on master cylinder internal parts.*

2. Press down on piston and spring assembly into the cylinder bore and install retaining clip (17) Retaining clip must be completely seated in groove on outlet side of piston bore. Install dust cover (18) and push rod (19).
3. Install cover (3) with gasket (4) on master cylinder reservoir. Snug screws (1) to fasten the cover to reservoir. Do not tighten screws at this time.
4. Align hole in brake hand lever with hole in master cylinder reservoir (6). From top of assembly, slide pivot pin (7) through reservoir and hand lever.
5. Install retaining clip (10) in pivot pin groove. Verify that retaining clip is completely seated in groove and verify proper function of master cylinder assembly.

## INSTALLATION

**CAUTION**

**Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)**

1. See Figure 2-39. Position brake lever/master cylinder assembly inboard of switch housing assembly engaging tab (2) on lower switch housing (1) in groove (3) at top of brake lever bracket (4).
2. Align holes in handlebar clamp with those in master cylinder housing and start both screws with flat washers. Position for rider posture. Beginning with top screw, tighten to 8-9 Nm (71-80 **in-lbs**) .

**CAUTION**

**Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)**

3. Position **new** copper washers on each side of hydraulic brake line fitting. Insert bolt through washers and fitting. Thread banjo bolt into master cylinder housing and tighten to 17-20 Nm (13-15 ft-lbs) .
4. Install length of clear plastic tubing over caliper bleeder valve, if removed. Place free end of tube in a clean container.
5. Stand the motorcycle upright so that master cylinder is level. Remove master cylinder cover.

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

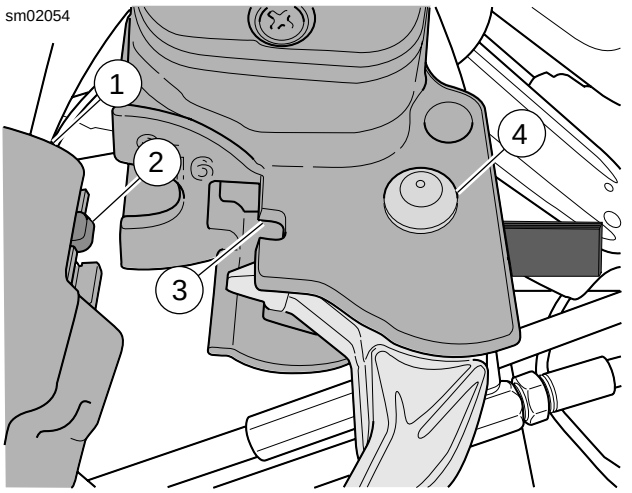
**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

6. Add D.O.T. 4 BRAKE FLUID to master cylinder reservoir until fluid level is 5.0 mm (13/64 in.) from top. Do not reuse old brake fluid. Use only D.O.T. 4 BRAKE FLUID from a sealed container.

**WARNING**

**After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)**

7. Bleed brake system. See 1.12 BLEEDING BRAKES.




1. **Lower switch housing assembly**
2. **Tab**
3. **Groove**
4. **Brake lever bracket**

**Figure 2-39. Master Cylinder and Brake Lever To Handlebar Switch Housing (typical)**

**WARNING**

**A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)**

8. Verify operation of master cylinder relief port. Actuate brake hand lever with cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.

9. Install gasket and cover on master cylinder. Tighten cover screws to 0.8-1.2 Nm (7-11 **in-lbs**) .

**WARNING**

**After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)**

10. Test brake system.
    a. Turn ignition switch ON. Pump brake hand lever to verify operation of brake lamp.
    b. Test ride motorcycle. If the brakes feel spongy, bleed the system again. See 1.12 BLEEDING BRAKES.

*NOTE*

*A sight glass enables the rider to visually check the brake fluid level without removing the master cylinder cover. When the reservoir is full, the sight glass is dark. As the fluid level drops, the glass lightens up to indicate this condition to the rider.*

## REMOVAL

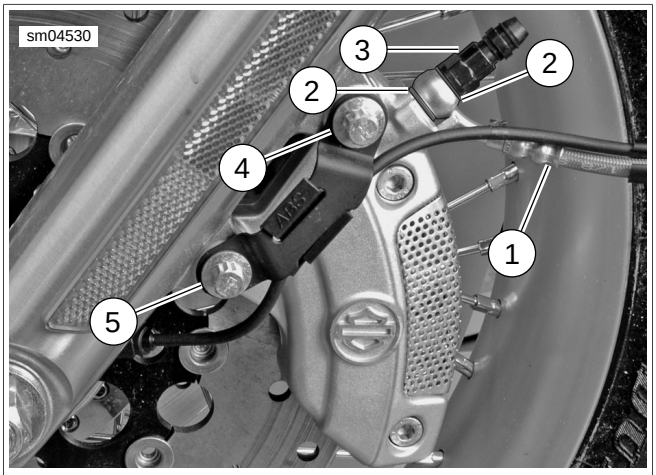
*NOTE*

*If only replacing brake pads, see 1.11 BRAKE PADS AND DISCS.*

**CAUTION**

**Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)**

1. Drain master cylinder reservoir using a suction device.
2. See Figure 2-40. Remove banjo bolt (3) and both copper washers (2) to detach front brake line (1) from caliper. Discard washers.
3. Remove both upper (4) and lower (5) mounting bolts (if ABS equipped, move ABS bracket out of the way). Lift caliper upward to remove from brake disc.
4. Repeat for opposite side caliper.




1. **Front brake line**
2. **Copper washer**
3. **Banjo bolt**
4. **Upper mounting bolt**
5. **Lower mounting bolt**

**Figure 2-40. Front Brake Caliper Mounting (ABS model shown)**

## INSTALLATION

1. Figure 2-40. Attach calipers to fork legs.
   a. Place caliper over brake disc with bleeder valve facing upwards.
   b. Place ABS bracket on caliper (if ABS equipped and left side only).
   c. Loosely install upper mounting bolt (4) into top hole on fork leg.
   d. Install lower mounting bolt (5) into bottom hole on fork leg. Tighten bottom mounting bolt to 43-52 Nm (32-38 ft-lbs) .
   e. Final tighten the top mounting bolt to 43-52 Nm (32-38 ft-lbs) .

**CAUTION**

**Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)**

2. Connect the brake line (1) to caliper using two **new** copper washers (2) and banjo bolt (3). Tighten to 23-26 Nm (17-19 ft-lbs) .
3. Repeat for opposite side caliper.

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

4. Remove cover from front brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is at FILL LEVEL when the motorcycle is level.
5. Tighten cover screws to 0.8-1.2 Nm (7-11 **in-lbs**) .

**⚠WARNING**

**After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)**

6. Bleed brake system and tighten bleeder valve. See 1.12 BLEEDING BRAKES.

**⚠WARNING**

**A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)**

7. Verify proper operation of the master cylinder relief port. Actuate the brake lever with the cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
8. Push diaphragm back in if extended and install gasket and cover on reservoir. Tighten to 0.8-1.2 Nm (7-11 **in-lbs**) .

**⚠WARNING**

**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

9. Test brake system.
   a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
   b. Test ride motorcycle. If brakes feel spongy, bleed the system again. See 1.12 BLEEDING BRAKES.

*NOTE*

*Avoid making hard stops for the first 160 km (100 miles). This allows the new pads to become conditioned to the brake discs.*

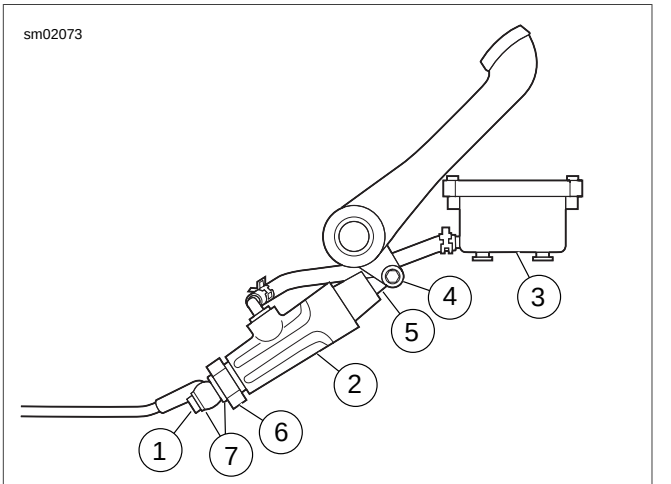
# REAR BRAKE MASTER CYLINDER AND RESERVOIR: FORWARD CONTROLS 2.18

## REMOVAL

*NOTE*

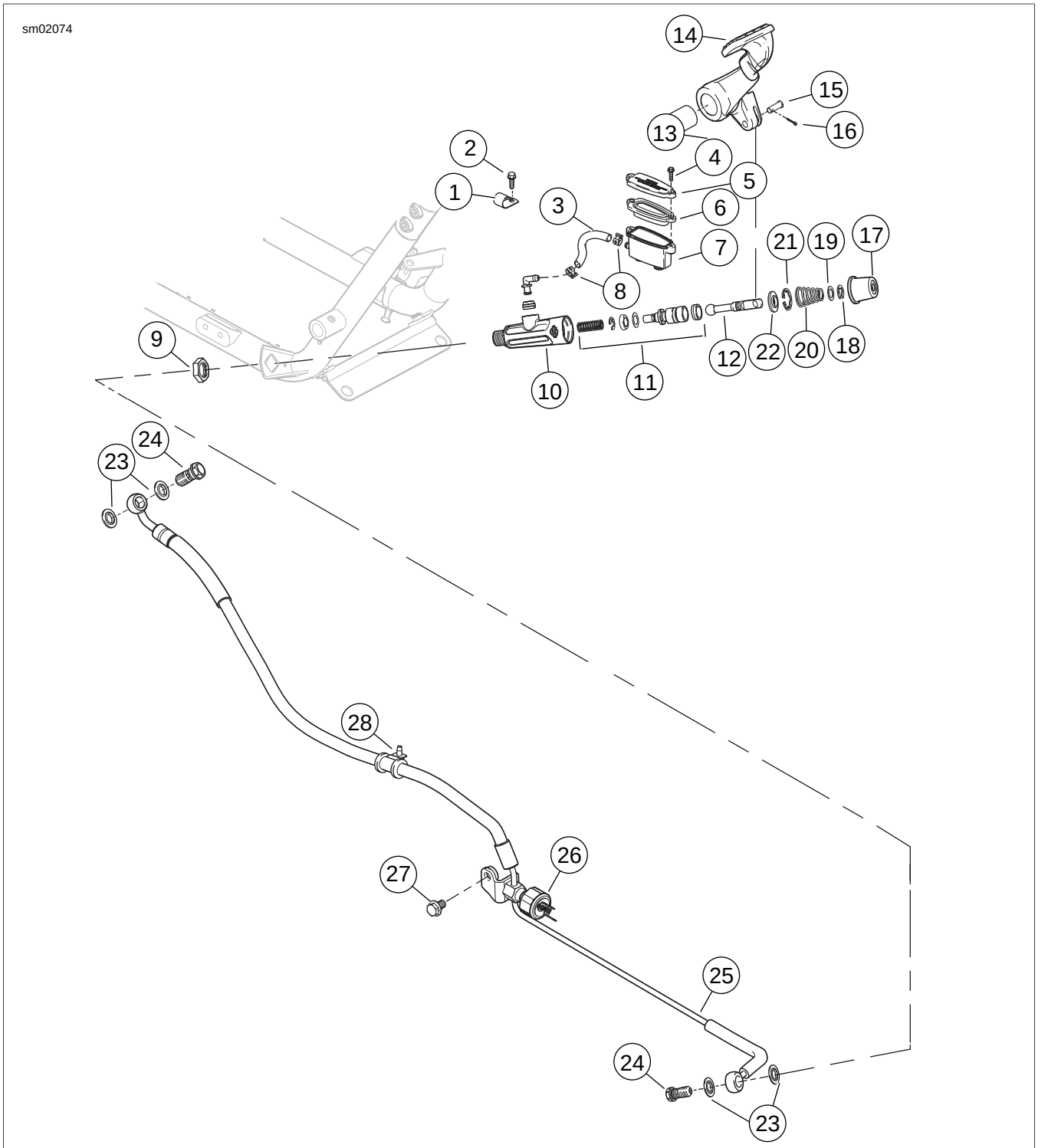
*Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.*

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove radiator right side cover.
3. See Figure 2-41. With a suitable container under the master cylinder, remove the banjo bolt (1). Discard the two copper washers (7).
4. Remove the clip from the clevis pin (4).
5. Cover the outside face of clevis pin (4) with cardboard and using a large pliers, squeeze the pin until the pin shoulder pops out of its interference fit with the clevis. Remove the clevis pin.
6. Remove the brake rod (5) from the clevis.
7. Pull remote reservoir from slot on radiator cover.
8. Remove jam nut (6) to free master cylinder from mounting bracket.
9. Remove master cylinder with the remote reservoir.




1. **Banjo bolt**
2. **Master cylinder**
3. **Remote reservoir**
4. **Clevis pin**
5. **Push rod**
6. **Jam nut**
7. **Steel/rubber washers**

**Figure 2-41. Rear Brake Master Cylinder & Reservoir**




1. Clip
2. Screw
3. Hose
4. Screw
5. Reservoir cover
6. Gasket
7. Reservoir
8. Clamps
9. Jam nut
10. Cartridge housing
11. Piston valve assembly
12. Push rod
13. Brake pedal bushing
14. Brake pedal
15. Clevis pin
16. Cotter pin
17. Dust seal
18. Retainer clip (small)
19. Washer
20. Spring
21. Retainer clip (large)
22. Retainer washer
23. Steel/rubber washers
24. Banjo bolts
25. Brake line
26. Stoplamp switch
27. Bolt
28. Frame clip

**Figure 2-42. Rear Brake Master Cylinder/Reservoir**

## DISASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-41137 | HOSE CLAMP PLIERS |

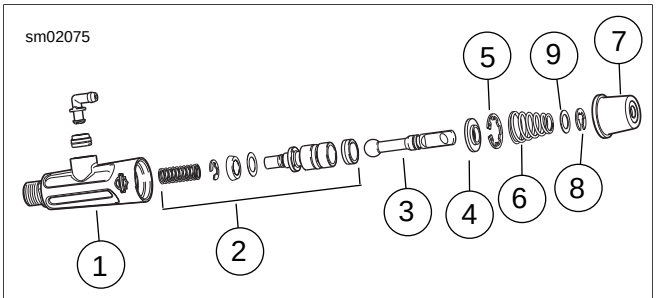
**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

1. See Figure 2-42. Remove reservoir cover (5) and gasket (6).




1. **Cartridge housing (shown w/elbow and o-ring)**
2. **Piston valve assembly (see VRSC parts manual)**
3. **Push rod**
4. **Retainer washer**
5. **Retainer clip (large)**
6. **Spring**
7. **Dust seal**
8. **Retainer clip (small)**
9. **Washer**

**Figure 2-43. Master Cylinder Components**

2. Over suitable container, use HOSE CLAMP PLIERS (Part No. HD-41137), to remove hose clamps (8) from reservoir hose (3). Drain reservoir (7) and hose.
3. Thoroughly clean exterior of master cylinder assembly with denatured alcohol.
4. Gently pull dust seal (17) from cartridge housing (10).

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

5. See Figure 2-43. Using hand pressure, push down on spring (6) and remove small retainer clip (8), washer (9) and remove spring.
6. Using hand pressure, push in push rod (3). Using a snap ring pliers, remove large retainer clip (5) and retainer washer (4).
7. Remove push rod (3).
8. Remove piston valve assembly (2) from cartridge housing (1).

## CLEANING AND INSPECTION

**⚠WARNING**

**Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)**

1. Clean all rubber parts using denatured alcohol. Check dust boot for cuts or tears. Replace as necessary.
2. Inspect threads on the cartridge body. Replace if threads are damaged.
3. Inspect spring for cracks or broken coils. Replace as necessary.
4. Wipe bore of cartridge housing with D.O.T. 4 BRAKE FLUID.
5. Inspect reservoir cover gasket for cuts, tears or general deterioration. Replace as necessary.

## ASSEMBLY

1. See Figure 2-43. Lubricate inner bore of cartridge housing (1) with D.O.T.4 brake fluid.
2. Install **new** piston valve assembly (2) from service parts kit.
3. Lay down a clean shop cloth and stand cartridge housing upright.

*NOTE*

*Apply a small drop of grease to each end of push rod before assembly. DO NOT use this grease on internal master cylinder parts.*

4. Insert ball end of push rod (3) into piston valve assembly (2). Using hand pressure, push down to compress spring. Install retainer washer (4), and larger retainer clip (5) using snap ring pliers into groove of cartridge housing.
5. Verify larger retainer clip has seated in groove of cartridge housing body.
6. Using hand pressure, push down on spring (6) and install small washer (9) and small retainer clip (8), locking small retainer clip into groove on push rod.
7. Verify small retainer clip has seated properly into groove on push rod.
8. Install dust seal (7) over push rod and seat base of dust seal into bore of cartridge housing until base of seal is below bore opening.

9. Test function of master cylinder assembly. Check for binding or excessive drag when pushing down on push rod.

## INSTALLATION

1. See Figure 2-42. Route remote reservoir (7) and hose (3) behind rear brake pedal (14). Press reservoir mounting studs into slots on radiator cover.
2. Fit square on bottom of master cylinder cartridge housing (10) into square hole of mounting bracket.
3. Install clevis pin (15) through the brake pedal clevis and master cylinder push rod (12).
4. Cover the face of clevis pin and clevis with cardboard. Holding the brake pedal firmly, tap on a rod to seat shoulder of clevis pin into clevis. Install new clip.
5. Apply LOCTITE® 243 (blue) to threads of jam nut (9). Thread jam nut on cartridge housing and tighten to 41-54 Nm (30-40 ft-lbs) .

*NOTE*

*To avoid leakage, verify that the banjo bolt, brake line fitting and master cylinder bore are completely clean.*

6. Lubricate **new** copper washers (7) with D.O.T. 4 BRAKE FLUID. Position washers on each side of brake line. Insert the banjo bolt through washers and fitting. Tighten to 23-26 Nm (17-19 ft-lbs) .
7. Stand the motorcycle upright so that the reservoir is in a level position. Clean and remove reservoir cover.

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

8. See Figure 2-44. Add D.O.T. 4 BRAKE FLUID to the master cylinder reservoir until the fluid level is 12.7 mm (1/2 in.) below top of reservoir and is visible in sight window at rear of reservoir. Use only D.O.T. 4 BRAKE FLUID from a sealed container.

**⚠WARNING**

**After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)**

9. Bleed brake system. See 1.12 BLEEDING BRAKES.
10. Install gasket and cover on master cylinder. Tighten cover screws to 0.7-0.9 Nm (6-8 **in-lbs**) .
11. Reinstall radiator side cover.
12. Reinstall maxi-fuse and right side cover.

**⚠WARNING**

**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

13. Test brake system.
    a. Turn ignition switch ON. Pump brake foot pedal to verify operation of brake lamp.
    b. Test ride motorcycle. If the brakes feel spongy, bleed the system again. See 1.12 BLEEDING BRAKES.




**Figure 2-44. Rear Brake Reservoir Sight Window (removed from motorcycle)**

## REMOVAL

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

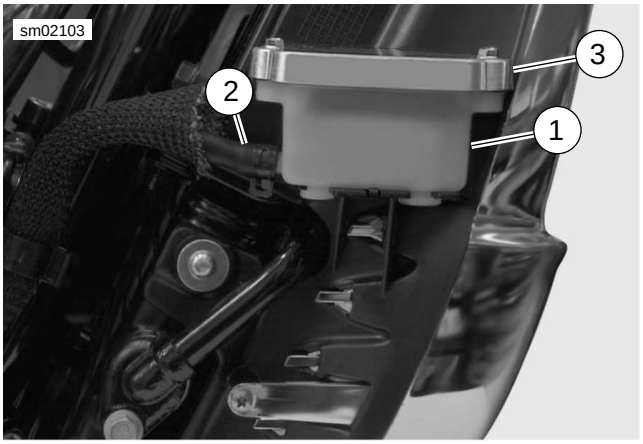
**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

*NOTE*

*When removing/replacing rear brake master cylinder or reservoir, DO NOT disturb the placement of the brake fluid supply line. Brake line placement is critical and it must remain positioned in on the inboard side of the frame rails.*

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove radiator right side cover.
3. See Figure 2-45. Place a suitable container under the master cylinder reservoir (1) and remove reservoir cover.
4. Carefully slide reservoir out of mount and drain brake fluid.
5. Remove reservoir hose (2) from reservoir.




1. **Rear brake reservoir**
2. **Remove reservoir hose**
3. **Reservoir cover**

**Figure 2-45. Rear Brake Reservoir**

## INSTALLATION

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

1. See Figure 2-45. Connect reservoir hose to reservoir and install clamp.
2. Carefully slide reservoir into it's mount.
3. Bleed rear brakes. See 1.12 BLEEDING BRAKES.
4. Install radiator side cover. See 1.6 RADIATOR SIDE COVERS.

# REAR BRAKE MASTER CYLINDER: MID-MOUNT CONTROLS 2.20

## REMOVAL

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

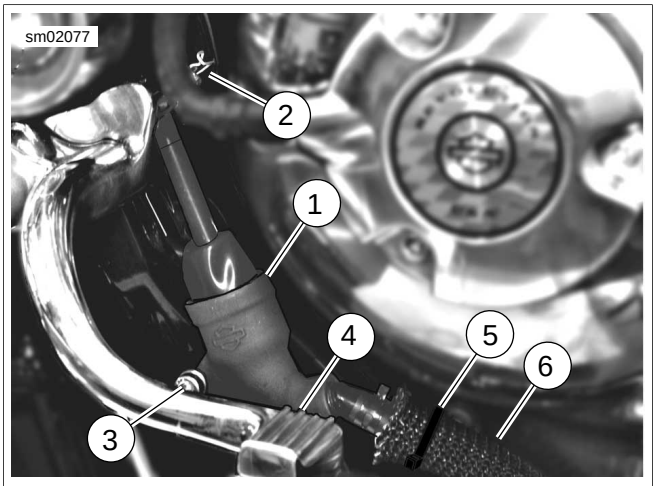
**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

*NOTE*

*When removing/replacing rear brake master cylinder or reservoir, DO NOT disturb the placement of the brake fluid supply line. Brake line must remain positioned in on the inboard side of the frame rails. Note position of tie wrap. If tie wrap must be removed, mark location and install exactly as removed.*

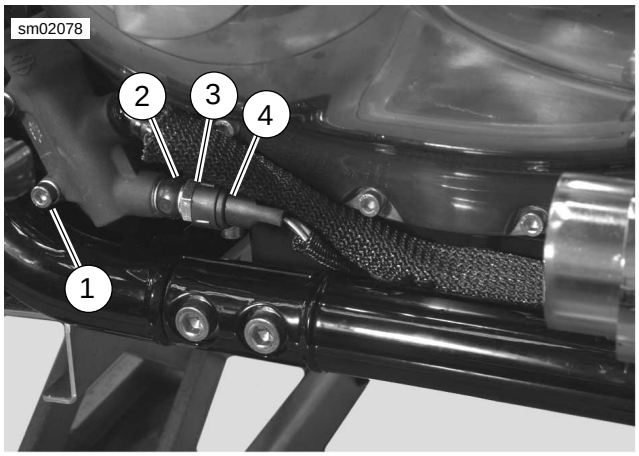
1. Drain master cylinder reservoir using a suction device.
2. Remove exhaust system. See 4.15 EXHAUST SYSTEM: VRSCD.
3. Remove right side rider foot control. See 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT.




1. **Master cylinder**
2. **Master cylinder brake pedal clip**
3. **Upper master cylinder fastener**
4. **Brake pedal**
5. **Tie wrap**
6. **Brake hose with heat sheathing**

**Figure 2-46. Rear Brake Master Cylinder and Clevis Pin Location**

4. See Figure 2-46. Remove master cylinder brake pedal clip (2).




1. **Lower master cylinder fastener**
2. **Brake line and washers**
3. **Brake light switch**
4. **Brake light switch connector**

**Figure 2-47. Brake Light Switch**

*NOTE*

*Protect painted areas for removal of brake line.*

5. See Figure 2-50. Remove brake light switch connector (4), brake line and washers (2) from bottom of master cylinder.
6. See Figure 2-46. Remove brake hose with heat sheathing (6) and clamp.
7. Remove upper and lower master cylinder fasteners.
8. Remove master cylinder from motorcycle.

## DISASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-41137 | HOSE CLAMP PLIERS |

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

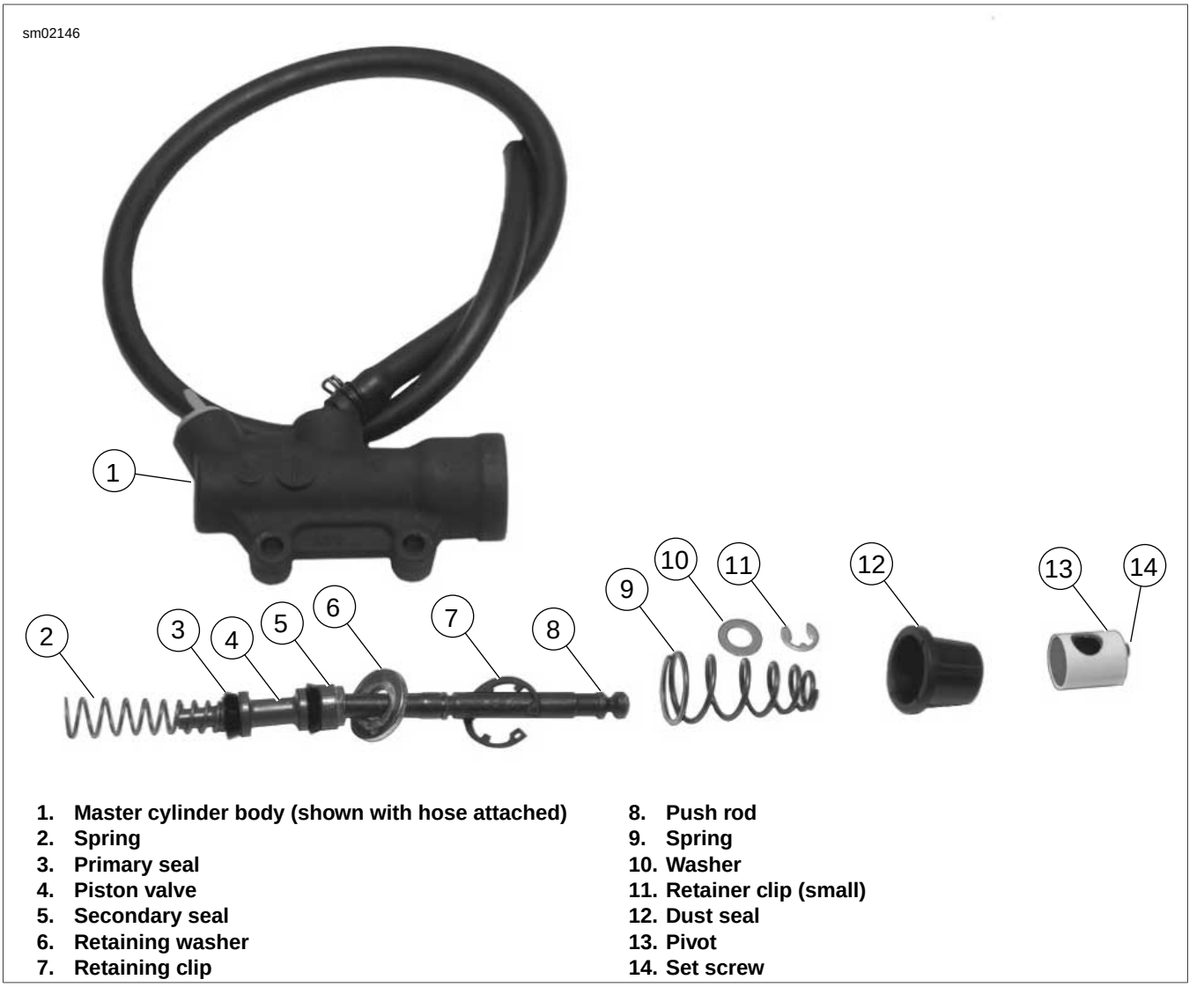
**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

1. Thoroughly clean exterior of master cylinder assembly with denatured alcohol.
2. See Figure 2-48. Remove pivot (13) by loosening set-screw (14) and remove dust seal (12).

**WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

3. Using hand pressure, push down on spring (9) and remove small retaining clip (11) and washer (10) and remove spring.
4. Using hand pressure, push in push rod (8) and remove large retaining clip (7) using a hose clamp pliers. HOSE CLAMP PLIERS (Part No. HD-41137)
5. Remove push rod.
6. Remove piston valve (4) containing primary seal (3) and secondary seal (5) from master cylinder body (1).




1. **Master cylinder body (shown with hose attached)**
2. **Spring**
3. **Primary seal**
4. **Piston valve**
5. **Secondary seal**
6. **Retaining washer**
7. **Retaining clip**
8. **Push rod**
9. **Spring**
10. **Washer**
11. **Retainer clip (small)**
12. **Dust seal**
13. **Pivot**
14. **Set screw**

**Figure 2-48. Rear Brake Master Cylinder/Reservoir (shown with supply hose attached)**

## CLEANING AND INSPECTION

**WARNING**

**Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)**

1. Clean all parts using denatured alcohol. Check dust boot for cuts or tears. Replace as necessary.
2. Inspect threads and bore in master cylinder body, inspect springs for cracks or broken coils, and inspect master cylinder internal parts. Replace if damaged.
3. Wipe bore of master cylinder body with D.O.T. 4 BRAKE FLUID.

## ASSEMBLY

To rebuild rear brake master cylinder, use components found in the Service Parts Kit.

**WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

1. See Figure 2-48. Lubricate inner bore of master cylinder body with D.O.T. 4 BRAKE FLUID.
2. Install **new** master cylinder repair kit (kit includes primary seal (3), secondary seal (5), piston valve (4), and spring (2).
3. Lay down a clean shop cloth and stand master cylinder assembly upright.

*NOTE*

*Apply a drop of grease (supplied with kit) to each end of push rod before assembly. DO NOT use this grease on master cylinder internal parts.*

4. See Figure 2-48. Insert ball end of push rod (8) into piston valve (4). Using hand pressure, push down to compress spring. Install washer (6) with cupped end toward spring and large retaining clip (7) into groove of master cylinder body bore.
5. Verify large retaining clip has seated in notches in master cylinder body.
6. Insert spring (9) into master cylinder body bore.
7. Using hand pressure, push down on spring and install small washer (10) and small retaining clip (11), locking small retaining clip into groove on push rod (8).
8. Verify small retaining clip has seated properly on push rod shaft.
9. Install dust seal (12) over shaft of push rod (8) and seat base of dust seal into bore of master cylinder body until base of seal is below bore opening.
10. Remove set screw (14) from pivot (13). Place a drop of LOCTITE® 242 on threads of set screw and install set screw into pivot.
11. Install pivot (13) on push rod end (8) and tighten set screw to 2-2.7 Nm ((18-24 **in-lbs**)) .
12. Test operation of master cylinder. Check for binding or excessive drag when pushing down on push rod.

## INSTALLATION

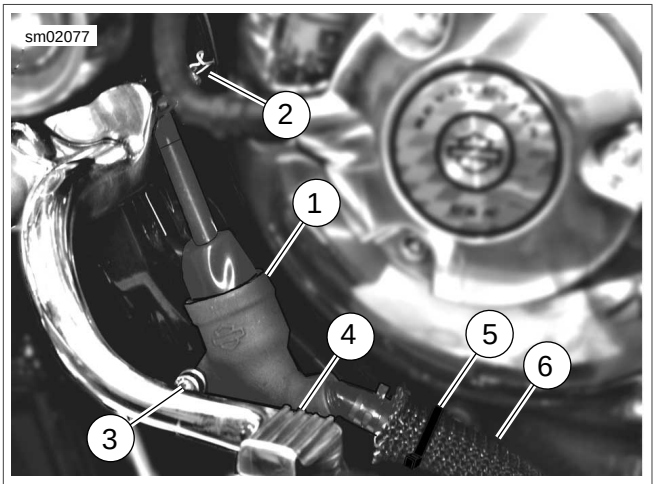
**CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

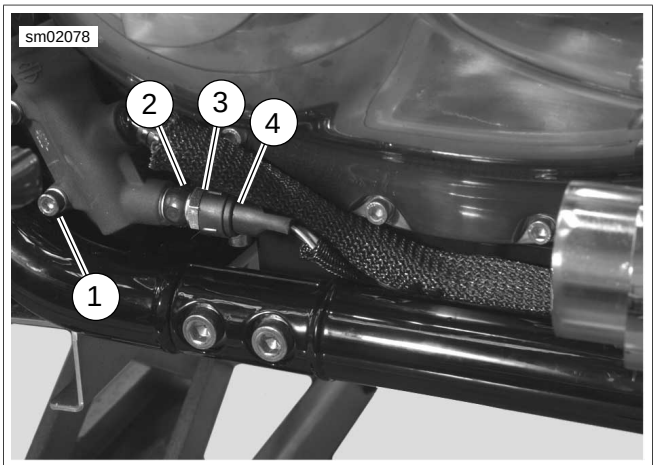
1. Install master cylinder to motorcycle and install upper and lower master cylinder fasteners. Tighten to 8-12 Nm (7-11 ft-lbs) .




1. **Master cylinder**
2. **Master cylinder brake pedal clip**
3. **Upper master cylinder fastener**
4. **Brake pedal**
5. **Tie wrap**
6. **Brake hose with heat sheathing**

**Figure 2-49. Rear Brake Master Cylinder and Clevis Pin Location**

2. See Figure 2-50. Install brake line (2) with **new** washers, install brake light switch (3), and tighten to 23-26 Nm (17-19 ft-lbs) .
3. See Figure 2-49. Install brake hose (6) and clamp.




1. **Lower master cylinder fastener**
2. **Brake line and washers**
3. **Brake light switch**
4. **Brake light switch connector**

**Figure 2-50. Brake Light Switch**

4. Install right side rider foot control. See 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT.

**⚠WARNING**

**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

5. Test brake system.
   a. Turn ignition switch ON. Pump brake hand lever to verify operation of brake lamp.
   b. Test ride motorcycle. If the brakes feel spongy, bleed the system again. See 1.12 BLEEDING BRAKES.

## REMOVAL

*NOTE*

*If removing caliper, remove brake pads first. If only replacing brake pads, do not remove rear brake caliper. Should pad replacement be necessary, see 1.11 BRAKE PADS AND DISCS.*

1. Drain master cylinder brake reservoir using a suction device.
2. Remove saddlebag if necessary to gain access to rear brake caliper.

**CAUTION**

**Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)**

3. Remove banjo bolt and both copper washers to detach rear brake line from caliper. Discard washers.
4. With motorcycle supported from underneath, remove fastener from caliper.

*NOTE*

*Caliper can be removed without rear wheel removal. Follow steps above and remove fastener shown and remove caliper. Fastener torques is 58-66 Nm (43-48 ft-lbs) .*

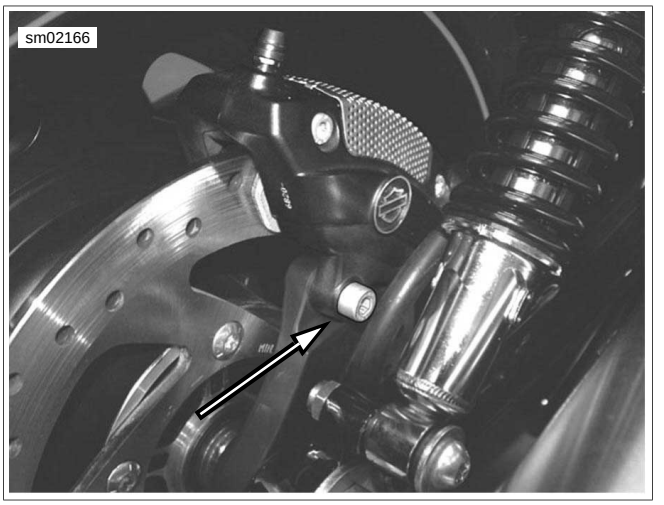



**Figure 2-51. Two-Piece Caliper Fastener Location**

5. Lift rear caliper away from axle and Swingarm.

## INSTALLATION

1. Place caliper on caliper bracket with notch inside Swingarm weldment. Verify that rubber bumper is contacting underside of the caliper weldment for the full length of bumper.
2. Install caliper to caliper bracket fastener and tighten to 58-66 Nm (43-48 ft-lbs) .

**CAUTION**

**Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)**

3. Connect brake line to caliper using two **new** copper washers and banjo bolt. Tighten to 23-26 Nm (17-19 ft-lbs) .

**⚠CAUTION**

**Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)**

**CAUTION**

**D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)**

4. Remove radiator side cover to access master cylinder. See 2.19 REAR BRAKE RESERVOIR: MID-MOUNT CONTROLS . Remove cover from rear brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is at the FILL LEVEL boss when the motorcycle is level.

**⚠WARNING**

**After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)**

5. Bleed brake system. See 1.12 BLEEDING BRAKES.
6. Install radiator side cover.
7. Test brake system.
   a. Turn ignition switch ON. Pump brake foot pedal to verify operation of brake lamp.
   b. Test ride motorcycle. If brakes feel spongy, bleed the system again. See 1.12 BLEEDING BRAKES.

*NOTE*

*Avoid making hard stops for the first 160 km (100 miles). This allows the **new** pads to become conditioned to the brake discs.*

## REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove rear view mirrors and turn signals.
3. Remove throttle cables from throttle control. See 2.11 THROTTLE CABLES.
4. Remove front brake master cylinder/reservoir, turn signal assembly, and throttle control from right handlebar. See 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
5. Remove switch housing from right handlebar. See 8.24 RIGHT HANDLEBAR SWITCH.
6. Cut clip holding wiring harness to right handlebar.
7. Remove clutch master cylinder/reservoir, turn signal assembly from left handlebar. See 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR.
8. Remove switch housing from left handlebar. See 8.25 LEFT HANDLEBAR SWITCH.
9. Cut clip holding wiring harness to left handlebar.
10. See Figure 2-52. To free lower end of top handlebar cover, loosen mounting bolts (3) holding headlamp bracket (2) to upper triple clamp (1).
11. See Figure 2-53. Without removing cover, remove fasteners (7) holding top handlebar cover (2) and instrument bezel (1) to lower handlebar cover (6).

*NOTE*

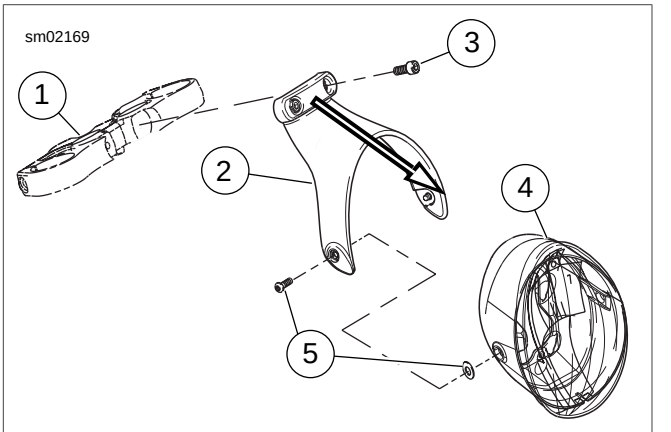
*See Figure 2-53. Snap and hook at bottom of bezel holding top cover to lower handlebar cover can be damaged if forced during removal or installation.*

12. From headlamp bracket end of cover, gently tilt top handlebar cover (2) and instrument bezel (1) up and back to remove cover and bezel.

*NOTE*

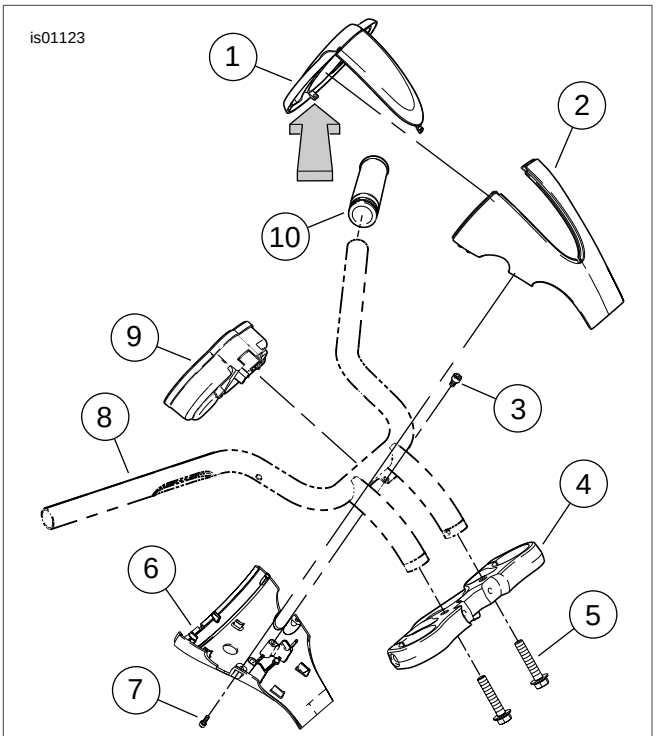
*Bezel can remain snapped to upper handlebar cover.*

13. Remove wiring harness connector to instrument cluster (9) and remove instrument cluster.
14. Remove fasteners (7) holding lower handlebar cover (6) to handlebars (8).
15. If necessary, remove the handgrip (10).
16. Remove fasteners (5) holding handlebars to upper triple clamp (4). Remove handlebars.




1. **Upper triple clamp**
2. **Headlamp bracket**
3. **Mounting bolt**
4. **Headlamp assembly**
5. **Headlamp assembly fastener and washer**

**Figure 2-52. Headlamp Bracket and Headlamp Assembly**




1. **Instrument bezel**
2. **Top handlebar cover**
3. **Lower cover fasteners**
4. **Upper triple clamp**
5. **Handlebar attaching screws (2)**
6. **Lower handlebar cover**
7. **Top handlebar cover fasteners**
8. **Handlebar**
9. **Instrument cluster**
10. **Left-side handlebar grip (not part of kit)**

**Figure 2-53. Handlebar Assembly**

## INSTALLATION

1. See Figure 2-53. Mount handlebars (8) on upper triple clamp (4). Tighten handlebar fasteners (5) to 41-47 Nm (31-35 ft-lbs) .
2. Mount lower handlebar cover (6) to handlebar (8). Tighten fasteners (3) to 6-10 Nm (53-88 **in-lbs**) .
3. Mount instrument cluster (9). Connect wiring harness to instrument cluster.

*NOTE*

*Snap holding bottom of bezel and top cover to lower handlebar cover can be damaged if forced during removal or installation.*

4. Orient instrument bezel and fit bezel hook over tab on lower handlebar cover. Gently tilt bezel (1) and top handlebar cover (2) until bezel hook snaps onto tab.
5. Fit top cover (2) under headlamp bracket. Bezel edge should fit snugly to grooved rim of lower and upper cover.
6. Install fasteners (7) that hold top handlebar cover (2), instrument bezel (1), and capture instrument cluster (9). Tighten fasteners to 1.3-1.9 Nm (12-16 **in-lbs**) .
7. See Figure 2-52. Tighten headlamp bracket (2) fasteners (3) to 11-18 Nm (9-13 ft-lbs) .

*NOTE*

*Before applying adhesive, clean the left handlebar with acetone.*

8. Install left handgrip:
   a. Using emery cloth, rough grip end of left handlebar.
   b. Apply LOCTITE PRISM PRIMER (770) to inside of **new** handgrip. Remove any excess PRISM PRIMER with a clean cloth. Wait two minutes for PRISM PRIMER to set before attempting the next step.
   c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of handgrip. Install handgrip on left handlebar.

*NOTE*

*SUPERBONDER will set in four minutes and be fully cured in 24 hours.*

9. Install left turn signal assembly, front brake master cylinder/reservoir, and brake hand lever, and throttle control handgrip. See 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
10. Install a **new** clip to hold the wiring harness to the left handlebar.
11. Install left handlebar switch housing. See 8.25 LEFT HANDLEBAR SWITCH.
12. Install throttle cable to throttle control handgrip. See 2.11 THROTTLE CABLES.
13. Install right turn signal assembly, clutch master cylinder/reservoir, and clutch hand lever assembly. See 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR.
14. Install a **new** clip to hold wiring harness to the right handlebar.
15. Install right handlebar switch housing. See 8.24 RIGHT HANDLEBAR SWITCH.
16. Install rear view mirrors and turn signals.
17. Install maxi-fuse and right side cover.

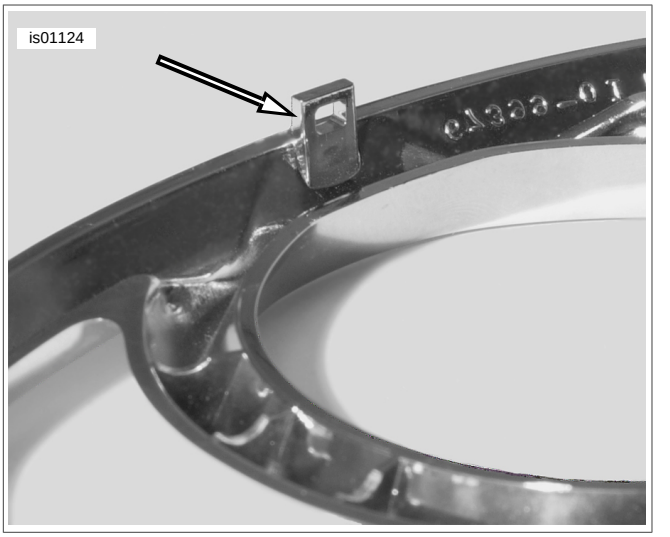



**Figure 2-54. Instrument Bezel Hook**

## REMOVAL

1. Loosen headlamp adjuster and lower headlamp/nacelle assembly to allow for procedure. See 1.27 HEADLAMP ALIGNMENT.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Remove rear view mirrors and turn signals.
4. Remove throttle cables from throttle control. See 2.11 THROTTLE CABLES.
5. Remove front brake master cylinder/reservoir, turn signal assembly, and throttle control from right handlebar. See 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
6. Remove switch housing from right handlebar. See 8.24 RIGHT HANDLEBAR SWITCH.
7. Cut clip holding wiring harness to right handlebar.
8. Remove clutch master cylinder/reservoir, turn signal assembly from left handlebar. See 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR.
9. Remove switch housing from left handlebar. See 8.25 LEFT HANDLEBAR SWITCH.
10. Cut clip holding wiring harness to left handlebar.
11. Remove the instrument cluster from the handlebar top clamp. See 8.15 INSTRUMENT CLUSTER: VRSCD/VRSCDX.
12. See Figure 2-56. Supporting the handlebars (3), loosen and remove the 4 fasteners (1) holding the top clamp (2).
13. Remove the handlebars (3).
14. If necessary, remove the handgrip.
15. If necessary, loosen and remove the two fasteners (5) securing riser (4) to upper fork clamp and remove the riser (4).

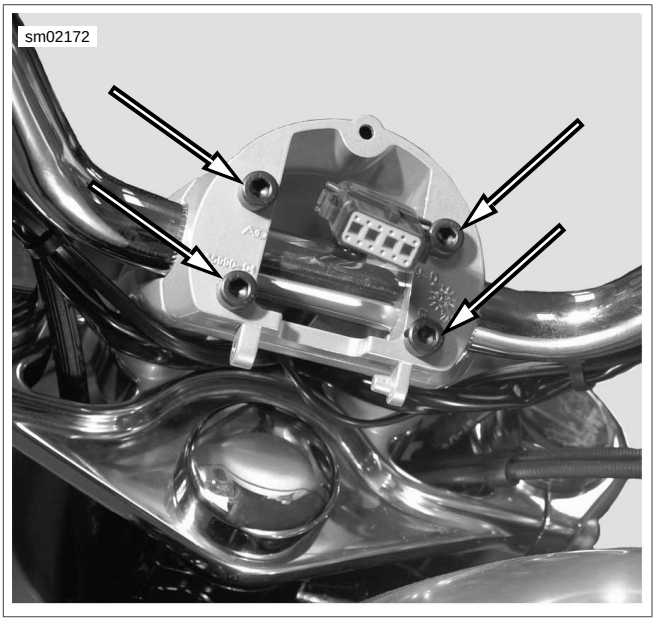
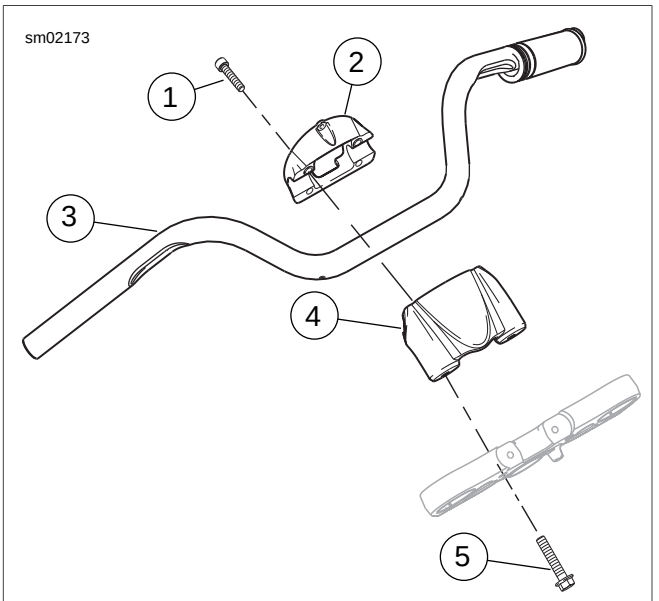



**Figure 2-55. Handlebar Top Clamp Fasteners (typical)**




1. **Top clamp fastener**
2. **Top clamp**
3. **Handlebar**
4. **Riser**
5. **Fastener**

**Figure 2-56. Top Clamp, Handlebar, and Riser (typical) (VRSCD shown)**

## INSTALLATION

1. Install cast riser on upper triple clamp. Tighten fasteners to 41-47 Nm (31-35 ft-lbs) .
2. Mount handlebar on riser with top clamp. Thread in and tighten fasteners to hold handlebar.

3. Center handlebars. Verify that equal amounts of knurled areas on handlebar protrude from sides of upper handlebar clamp.
4. See Figure 2-56. Position handlebars for rider posture and hold in position.
5. Tighten two front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp.
6. Tighten rear fasteners to 16-20 Nm (144-180 **in-lbs**).
7. Final tighten front fasteners to 16-20 Nm (144-180 **in-lbs**). Slight gap between upper and lower clamps should exist at rear.
8. Install instrument cluster. See 8.15 INSTRUMENT CLUSTER: VRSCD/VRSCDX.

*NOTE*

*Before applying adhesive, clean the left handlebar with acetone.*

9. If removed, install left handgrip:
   a. a. Using emery cloth, rough grip end of left handlebar.
   b. b. Apply LOCTITE PRISM PRIMER (770) to inside of **new** handgrip. Remove any excess PRISM PRIMER with a clean cloth. Wait two minutes for PRISM PRIMER to set before attempting the next step.
   c. c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of handgrip. Install handgrip on left handlebar.

*NOTE*

*SUPERBONDER will set in four minutes and be fully cured in 24 hours.*

10. Install left turn signal assembly, front brake master cylinder/reservoir, and brake hand lever, and throttle control handgrip. See 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
11. Install a **new** clip to hold the wiring harness to the left handlebar.
12. Install left handlebar switch housing. See 8.25 LEFT HANDLEBAR SWITCH.
13. Install throttle cable to throttle control handgrip. See 2.11 THROTTLE CABLES.
14. Install right turn signal assembly, clutch master cylinder/reservoir, and clutch hand lever assembly. See 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR.
15. Install a **new** clip to hold wiring harness to the right handlebar.
16. Install right handlebar switch housing. See 8.24 RIGHT HANDLEBAR SWITCH.
17. Install rear view mirrors and turn signals.
18. Install Maxi-Fuse.
19. Adjust and tighten headlamp bracket to 34-41 Nm (25-30 ft-lbs).

## GENERAL

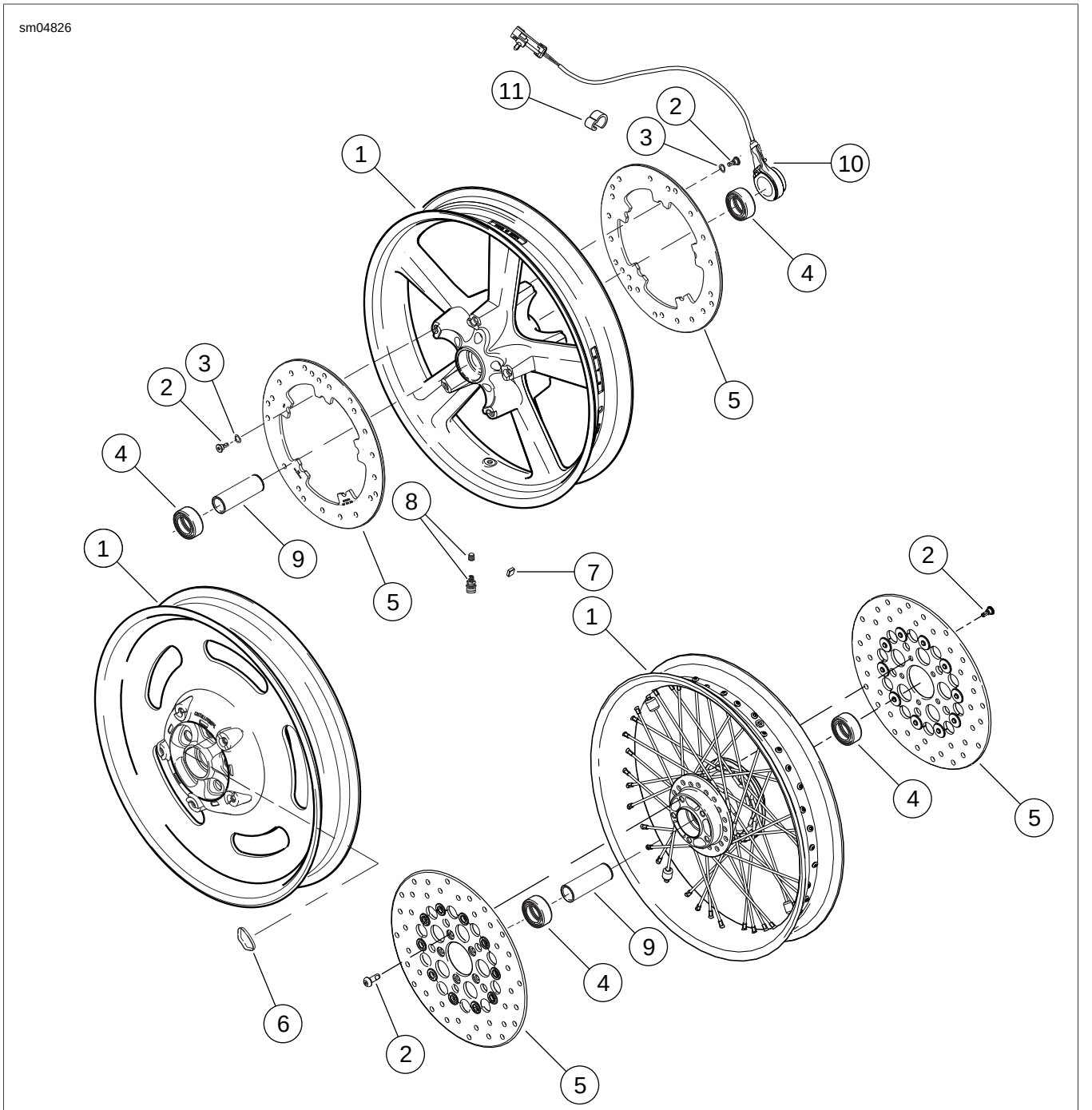
Maximum tire mileage and good handling qualities are directly related to wheel and tire care. Wheels and tires should be inspected regularly for wear. If handling problems occur, check 1.28 TROUBLESHOOTING for possible causes.

### Preliminary Inspection - Brake Discs

1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
2. If warped, replace disc. Maximum allowable lateral runout of a spring washer mounted brake disc is 0.3 mm (0.012 in.).
3. If scored, replace disc.

### Preliminary Inspection - Wheel/Tire

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect tire for wear and wear pattern. Replace tire as necessary.
3. Inspect air valve. Replace as necessary.
4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See 2.28 SEALED WHEEL BEARINGS.




1. **Wheel (optional wheels shown)**
2. **Bolt (5 per brake disc)**
3. **Spring washer (5 per brake disc)**
4. **Bearing (ABS uses specific right and left bearings, NON-ABS bearings are identical left and right)**
5. **Brake disc (2)**
6. **Plug (10 - used only on disc-type wheels)**
7. **Balance weight**
8. **Air valve cap**
9. **Sleeve**
10. **Wheel speed sensor**
11. **Cable clip**

**Figure 2-57. Front Wheel Components**

## REMOVAL

1. Block motorcycle underneath frame so front wheel is off the ground.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

2. Remove right side cover and maxi-fuse.
3. See Figure 2-58. On ABS models, release front wheel speed sensor cable from clip.
4. See Figure 2-59. Remove both upper and lower mounting bolts to remove brake caliper assembly.
5. Support calipers using a rubber bungee cord. Be careful not to scratch fender or fork slider finish.
6. Repeat to remove opposite caliper.

*NOTE*

*Do not operate front brake lever with the front wheel removed or the caliper piston may be forced out of piston bore.*

7. See Figure 2-60. Loosen pinch bolt (2) in right side axle holder (4).
8. Insert screwdriver or steel rod through hole in axle (1) on right side. While holding axle stationary, remove axle nut (5).
9. Pull axle out while retaining the left and right inner wheel spacers, and front wheel speed sensor (if ABS equipped).

*NOTE*

- *If ABS equipped, never pull wheel speed sensor cable tight or use to retain wheel, axle or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

10. Remove wheel assembly from forks.

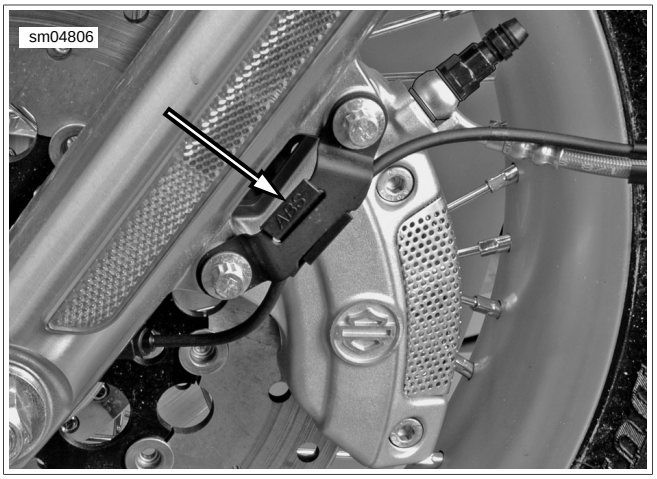



**Figure 2-58. Front Wheel Speed Sensor Cable Clip (ABS Equipped)**

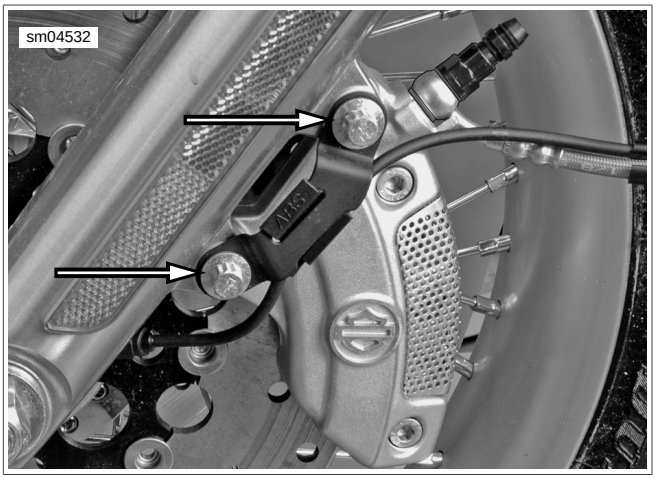
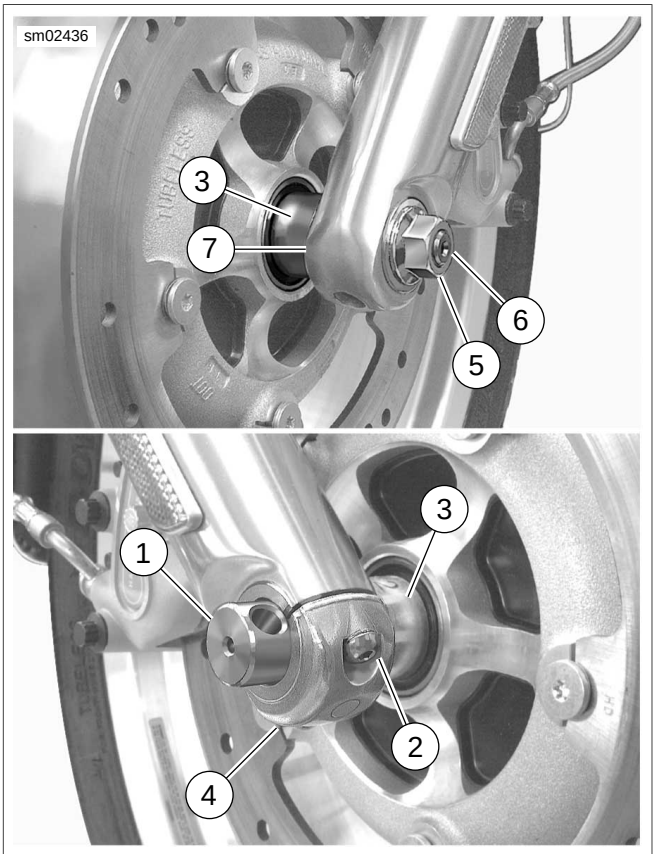



**Figure 2-59. Caliper Mounting Bolts (typical, ABS model shown)**




1. **Axle**
2. **Pinch bolts (screws)**
3. **Left and right inner wheel spacer**
4. **Axle holder (right side only)**
5. **Axle nut**
6. **Bolt**
7. **Spring washer**

**Figure 2-60. Front Wheel Mounting (VRSCAW/VRSCD)**

## DISASSEMBLY

*NOTE*

*See 2.30 TIRES to service tire or valve stem assembly.*

1. Remove spacers from left and right sides.
2. If tire replacement is necessary, remove tire and valve stem. See 2.30 TIRES.
3. If wheel bearing replacement is necessary, remove the sleeve and press out the sealed wheel bearings. See 2.28 SEALED WHEEL BEARINGS.
4. If it is necessary to remove brake discs and if wheel is to be assembled with same discs, mark both wheel and discs, so they can be installed in their original locations.
5. See Figure 2-57. If removing brake discs (5), remove five bolts (2) and spring washers (3) securing brake disc to the wheel (1). Repeat procedure to remove disc on opposite side of wheel. Discard bolts and spring washers.

## CLEANING AND INSPECTION

1. Thoroughly clean all parts (except wheel bearings, or wheel speed sensor if ABS equipped) in solvent. Wipe bearings or ABS sensors with damp cloth.
2. Inspect all parts for damage or excessive wear.

**⚠WARNING**

**Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)**

3. Inspect brake discs. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc. Also replace discs if warped or badly scored. See 1.11 BRAKE PADS AND DISCS.

*NOTE*

*Minimum thickness is measured from backing plate.*

4. Inspect brake pads. Minimum brake pad thickness is 0.4 mm (0.016 in.).

## ASSEMBLY

**⚠WARNING**

**Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)**

*NOTE*

*Always install first of two bearings on the side opposite the valve stem side of the wheel.*

1. If sealed wheel bearings must be serviced, always replace bearings as a complete set. See 2.28 SEALED WHEEL BEARINGS.

**⚠WARNING**

**Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)**

2. If necessary, mount tire, valve stem and balance wheel assembly as required. See 2.30 TIRES.
3. Verify that wheel and tire are true. See 2.30 TIRES and 2.29 DISC RIM RUNOUT.
4. See Figure 2-57. If necessary, install brake discs in their original positions. Verify that brake disc is clean.
   a. On left side of wheel, install five **new** bolts (2) and five **new** spring washers (3) to attach left brake disc. Tighten bolts to 22-33 Nm (16-24 ft-lbs).
   b. On right side of wheel, install five **new** bolts (2) and five **new** spring washers (3 to attach right brake disc. Tighten bolts to 22-23 Nm (16-24 ft-lbs).
5. After wheel is balanced, apply a light coat of LOCTITE® ANTI-SEIZE LUBRICANT to axle, bearing bores, and bore of inner sleeve.

*NOTE*

*If ABS equipped, never pull wheel speed sensor cable tight or use to retain wheel, axle or other components. Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

6. See Figure 2-57. Install wheel speed sensor (if ABS equipped), slide front axle into place and pivot wheel speed sensor upward until tab stops sensor on fork leg as shown.
7. See 2.29 DISC RIM RUNOUT. Tighten front axle nut according to procedure.
8. See Figure 2-62. Install ABS sensor clip as shown (if ABS equipped).
9. See Figure 2-63. Install ABS cable clips as shown (if ABS equipped).
10. See 2.28 SEALED WHEEL BEARINGS. Install Maxi-Fuse.

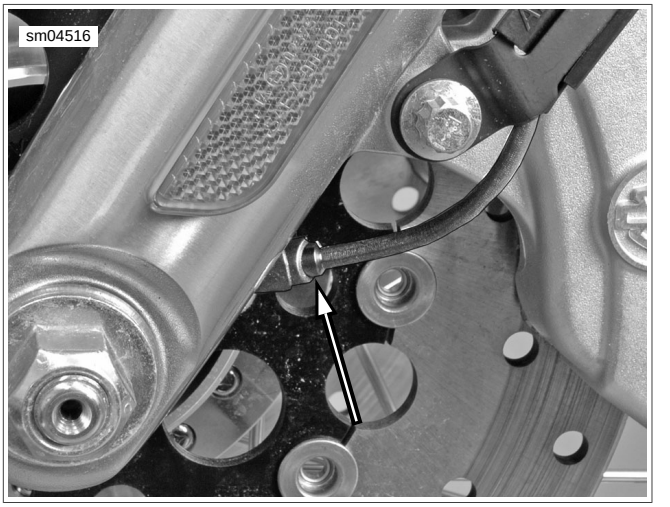
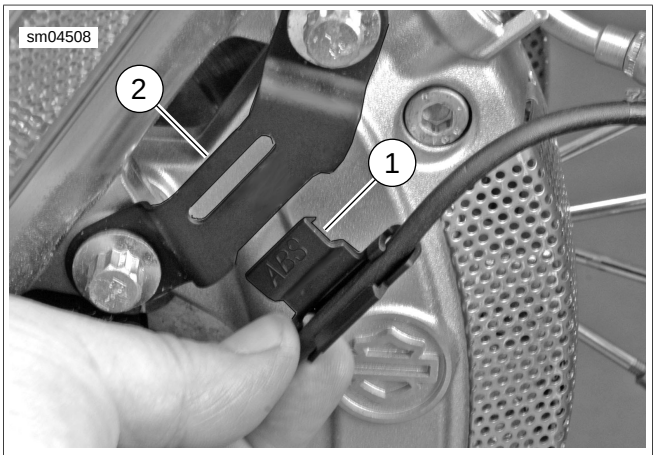



**Figure 2-61. Front ABS Sensor Positioning**




1. **ABS Sensor Cable Clip**
2. **ABS Sensor Cable Clip Bracket**

**Figure 2-62. ABS Sensor Cable Clip**




**Figure 2-63. ABS Sensor Cable to Brake Hose Clips**

## INSTALLATION

*NOTE*

*Drill bit shown in illustrations is used ONLY for axle nut tightening procedure. Right side fork leg alignment should follow written procedure.*

1. Apply a light coat of LOCTITE® ANTI-SEIZE LUBRICANT to axle, bearing bores, bore of left and right spacers, bore of brake caliper mount, and bore of inner sleeve.
2. See Figure 2-64. Place wheel and spacers into front fork and install axle (5). Verify that axle spacers on right and left side are properly installed.
3. Thread on the axle nut. Insert drill bit, screwdriver or steel rod through hole in axle on right side of vehicle. While holding axle stationary, tighten axle nut to 68-75 Nm (50-55 ft-lbs) .
4. Pull fork leg so that it just contacts the inner wheel spacer and then tighten axle holder pinch bolt (2) to 16 Nm (11 ft-lbs) . Ensure that gap between the axle holder (3) and the fork slider (1) is equal at front and rear of axle holder.
5. Remove drill bit, screwdriver or steel rod from axle hole.
6. Install the brake caliper to the fork legs.
   a. Loosely install long mounting bolt into top hole on fork leg.
   b. Install short mounting bolt into bottom hole on fork leg. Tighten bottom mounting bolt to 43-52 Nm (32-38 ft-lbs) .
   c. Final tighten top mounting bolt to 43-52 Nm (32-38 ft-lbs) .
7. Repeat step 6 to install brake caliper on other side of wheel.

**⚠WARNING**

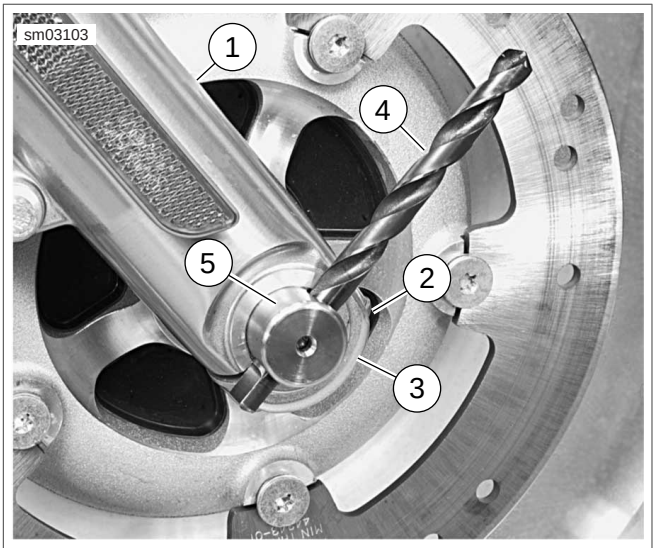
**Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)**

8. Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads.

**⚠WARNING**

**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

9. Reinstall maxi-fuse and right side cover.




1. **Fork slider**
2. **Axle holder pinch bolt**
3. **Axle holder**
4. **Drill bit, screwdriver or steel rod**
5. **Axle**

**Figure 2-64. Aligning Fork to Wheel (VRSCAW/VRSCD)**

## PROCEDURE

*NOTE*

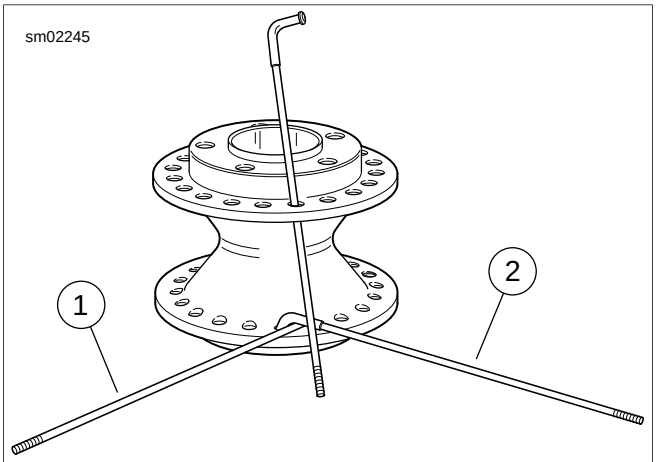
*If only rim is to be replaced, tape spokes together to hold position on hub and remove spokes from rim. Install taped hub/spoke assembly to new rim and tighten spokes. Then remove tape and true wheels.*

1. Divide spokes into two groups.
   a. Inner spokes have long heads.
   b. Outer spokes have short heads.
2. Lubricate spoke threads and nipple shoulders with tire mounting lubricant.

*NOTE*

*The primary brake disc side of the hub can be identified by having one or two grooves cut into the disc mounting surface.*

3. See Figure 2-65. Place hub on bench with the primary brake disc side up. Insert one outer spoke (short head) into any bottom flange hole and swing it clockwise. Insert an inner spoke (long head) in the next hole to the left of the outer spoke. Swing the inner spoke counterclockwise over the outer spoke.
4. Find the hole in the upper flange directly above the two spokes just inserted. This hole uses a long head inner spoke. Insert inner spoke into the hole on the upper flange that directly bisects the two spokes in the bottom flange. Insert all remaining spokes in upper flange alternating the inner and outer spokes.
5. After one flange side is completed flip wheel hub upside down and repeat to finish other flange.
6. See Figure 2-66. With all forty spokes inserted in hub, group all spokes on top flange into two bundles. Secure each group with throttle grips to keep the spokes together.




**1. Outer spoke (short head)**
**2. Inner spoke (long head)**

**Figure 2-65. Lacing 19 Inch Wheel Hub**

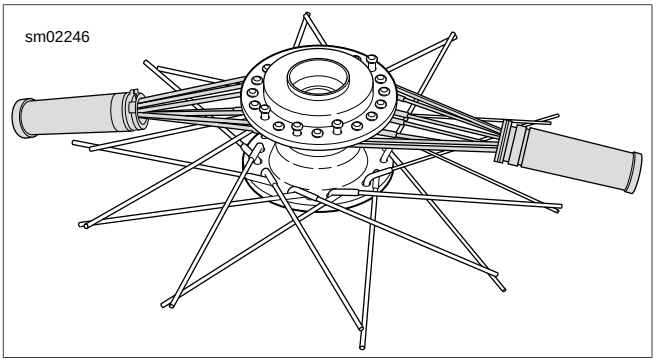



**Figure 2-66. Bundling Top Spokes**

7. Swing all bottom flange outer spokes (short head) clockwise.
8. Swing the inner spokes (long head) counterclockwise, crossing over the outer spokes (short head).
9. Angle all spokes as far as they will go without overlapping the next LIKE spoke. For instance, swing an inner spoke (long head) counter clockwise across four spokes as far as it will go before crossing another inner spoke (laced in a cross-four pattern).

*NOTES*

- *All inside spokes lay over all outside spokes.*
- *See Figure 2-67. The valve stem hole is centered of the rim; you do not have to worry about choosing the correct relationship between the rim and the hub.*

10. Center the rim over the hub assembly.

*NOTE*

*It is recommended that you lace the first spoke next to the valve stem hole. When lacing your first spoke, place spoke nipples through several rim holes to determine the correct lacing direction. Only one spoke will fit into the spoke nipple correctly. When connecting the spoke to the spoke nipple, finger tighten two to three threads.*

11. Straighten any spokes that were accidentally bumped or moved on the bottom flange.
12. Work with the bottom flange of outer spokes (short head) first.
13. See Figure 2-68. Using the spoke alignment method discussed previously, locate a hole pointing downward and outward toward the bottom flange of outer spokes (short head).
    a. Verify outer spoke (short head) reaches the spoke nipple and secure spoke loosely by hand. Skip three rim holes and repeat lacing. Follow pattern to complete bottom flange outer spokes (short head).
    b. See Figure 2-69. Once you have completed lacing the bottom row of outer spokes (short head) double check for three empty holes in between each spoke.

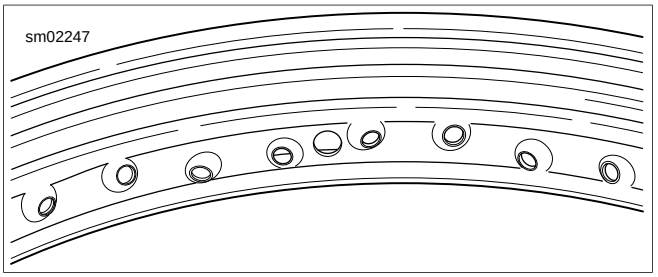



**Figure 2-67. Valve Stem Hole Location**

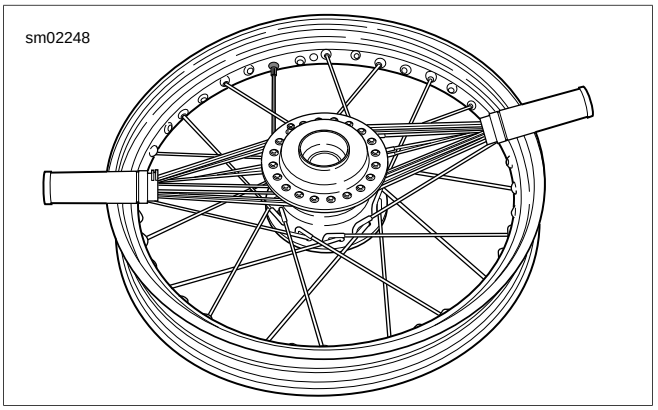



**Figure 2-68. Beginning Spoke: Bottom Flange Outer**

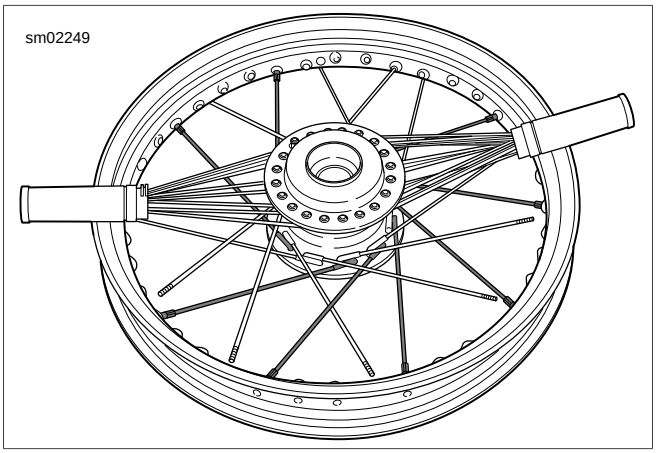



**Figure 2-69. Completed Spokes: Bottom Flange Outer**

14. Work with bottom flange inner spokes (long head) next. Choose a beginning spoke closest to the valve stem hole.
    a. See Figure 2-70. Each inner spoke (long head) crosses four outer spokes (short head).
    b. See Figure 2-71. Verify inner spoke reaches spoke nipple and secure spoke loosely by hand. Skip every other hole and repeat lacing. Follow pattern to complete bottom row inner spokes (long head).
15. See Figure 2-72. Undo each top bundle and fan the spokes out (in a starburst pattern) around the top rim edge.

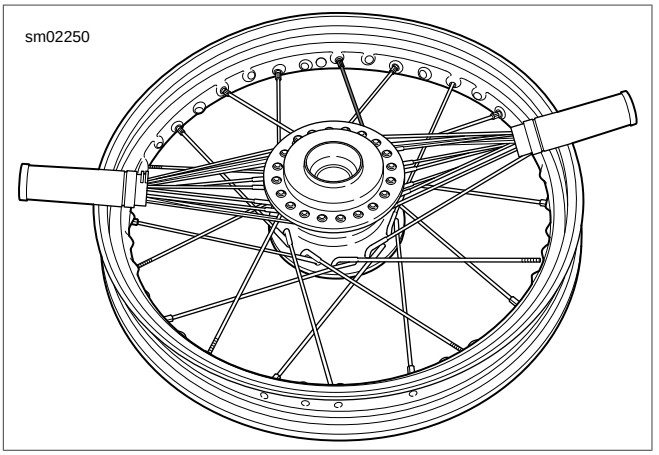



**Figure 2-70. Beginning Spoke: Bottom Flange Inner**

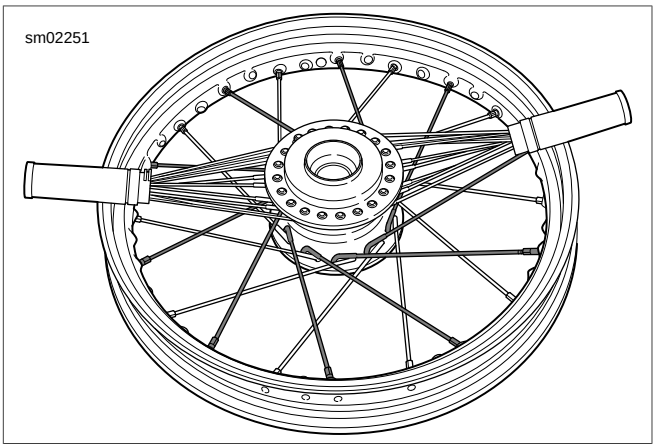



**Figure 2-71. Completed Spokes: Bottom Flange Inner**

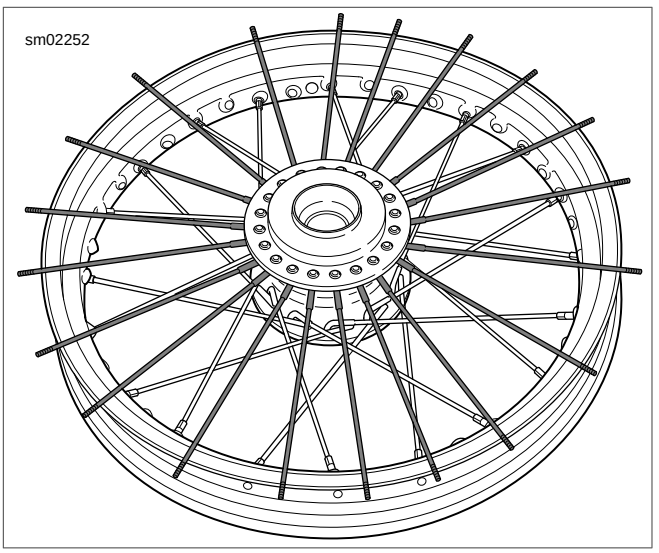



**Figure 2-72. Fanning Top Flange Spokes**

16. See Figure 2-73. Point all the top flange inner spokes (long head) clockwise one at a time leaving the outer spokes (short head) resting on the rim.

*NOTE*

*Do not knock outer spokes (short head) under inner spokes (long head) or they will be trapped underneath the inner row of spokes.*

17. Using the spoke alignment method discussed previously, choose a beginning spoke closest to the valve stem hole. Start with top flange inner spokes (long head) first.
    a. See Figure 2-74. Verify spoke reaches spoke nipple and secure spoke by hand. Follow pattern to complete top flange inner spokes (long head).
    b. See Figure 2-75. Once you have completed the top flange of inner spokes (long head) double check for one empty hole after every third spoke.

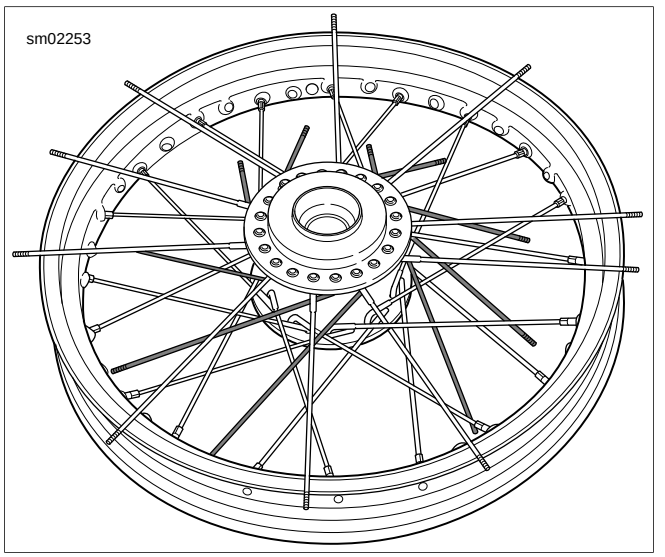



**Figure 2-73. Setting Top Flange Inner Spokes**

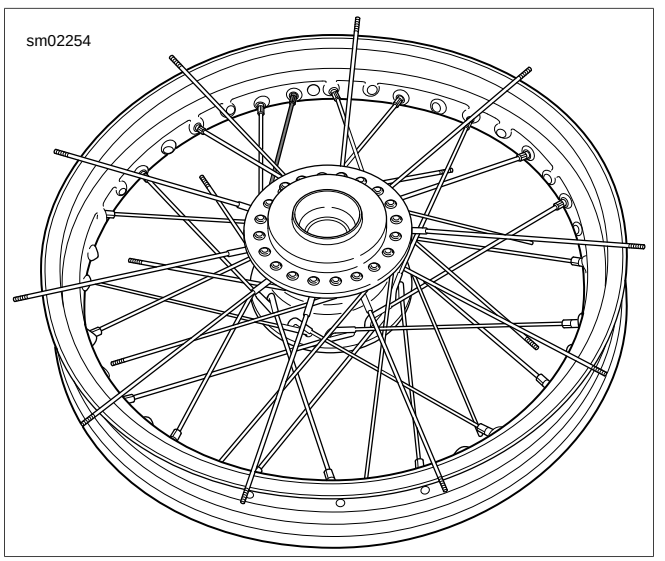



**Figure 2-74. Beginning Spoke: Top Flange Inner**

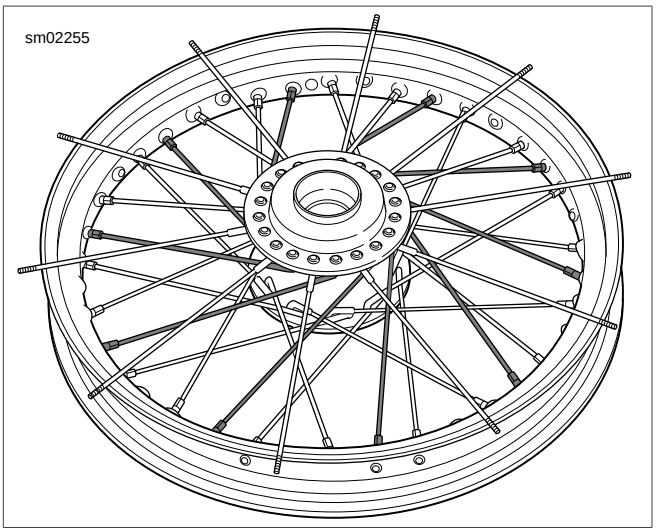



**Figure 2-75. Completed Spokes: Top Flange Inner**

18. See Figure 2-76. Finish with top flange outer spokes (short head). Point the top flange outer spokes (short head) counterclockwise and make sure each one crosses four inner spokes before securing it to the rim.
19. See Figure 2-77. Verify spoke reaches spoke nipple and secure spoke by hand. Follow pattern to complete top flange outer spokes (short head).
20. Tighten spoke nipples to specification listed in Table 2-8.
21. True the wheel. See 2.26 TRUING LACED WHEELS.

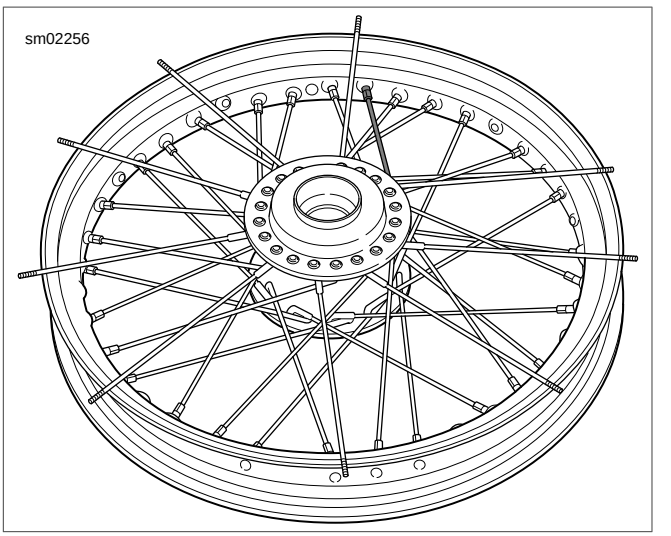



**Figure 2-76. Beginning Spoke: Top Flange Outer**

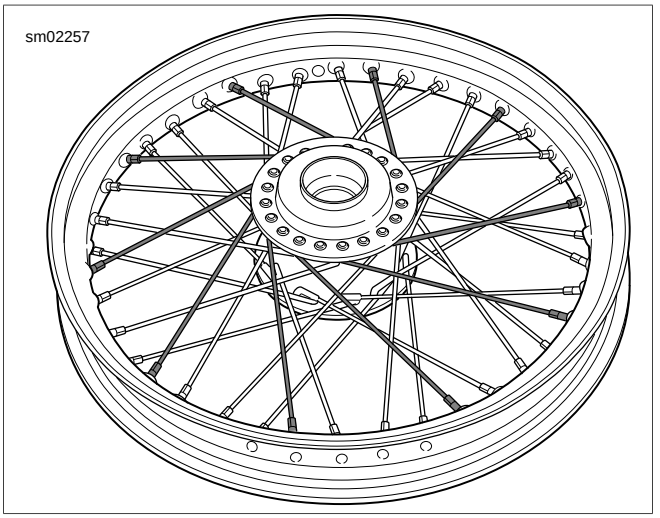



**Figure 2-77. Completed Spokes: Top Flange Outer**

**Table 2-8. Spoke Nipple Torque Specification**

| RIM TYPE | TORQUE |
|---|---|
| All | 6.2-7.3 Nm (55-65 **in-lbs**) |

## GENERAL

The rim must be trued both laterally and radially. If **new** bearings were installed, wheels may be trued with only the bearings and center spacer installed.

## LATERAL TRUING

| PART NUMBER | TOOL NAME |
|---|---|
| HD-94681-80 | SPOKE WRENCH |
| HD-99500-80 | WHEEL TRUING STAND |

1. Divide the wheel spokes into ten groups of four and mark the center of each group with a piece of tape. The groups should be directly across from one another and approximately 90 degrees apart. Tighten the spokes in these four groups finger tight.
2. See Figure 2-78. Install truing arbor in wheel hub and place wheel in WHEEL TRUING STAND (Part No. HD-99500-80). Tighten arbor nuts so hub will turn on its bearings.

*NOTE*

*The primary brake disc side of the hub can be identified by having one or two grooves cut into the disc mounting surface.*

3. Lay a straightedge across primary brake disc mounting surface of hub and one of the marked spoke groups.
4. See Figure 2-80 and Table 2-9. Measure distance "A" from the straightedge to the location as shown.

*NOTES*

- *Tighten or loosen spoke, one flat at a time, and recheck measurement.*
- *Always loosen the appropriate spokes before tightening the other two. Reversing this procedure will cause the rim to become out-of-round.*

5. If the dimension is not correct, tighten the four spokes accordingly. Use SPOKE WRENCH (Part No. HD-94681-80). For example, If the measurement on the **right** rim edge side is **less** than it should be, **loosen** the two spokes attached to the hub **right** side and **tighten** the two spokes attached to the hub **left** side. Turn all four spokes an equal number of turns until offset dimension is correct.
6. Repeat the previous step for all ten groups on the wheel.




**Figure 2-78. Front Wheel Hub Offset Dimension**

**Table 2-9. Offset Dimensions**

| RIM TYPE | RIM SIZE | IN. | MM. |
|---|---|---|---|
| Chrome aluminum profile laced | 19 | 0.890-0.910 | 22.68-23.19 |

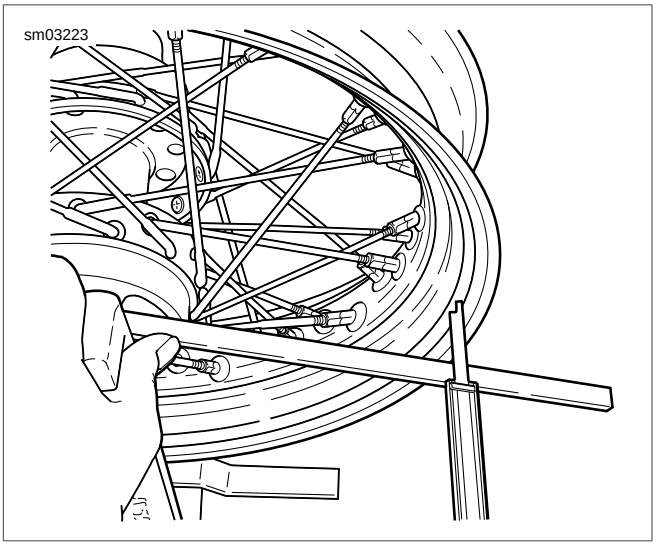


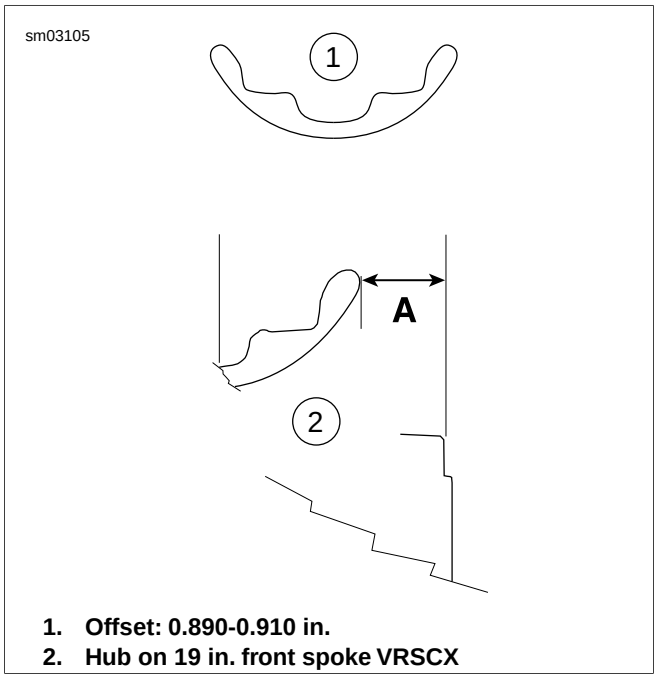

**Figure 2-79. Rear Wheel Hub Offset Dimension**

## RADIAL TRUING

1. See Figure 2-81. Adjust truing stand gauge to the rim's tire bead seat as shown. The rim should be trued within 0.76 mm (0.030 in.).
2. Spin the rim slowly. If the rim contacts the gauge on or near a marked group of spokes, loosen the spokes in the marked group on the opposite side of the rim. Now tighten

the spokes in the group where the rim makes contact. Loosen and tighten spokes an equal number of turns.

3. If the rim contacts the gauge between two marked groups, loosen the spokes in both opposite groups and tighten the spoke groups on the side of the rim that makes contact.
4. When the wheel is centered and trued, start at the valve hole and tighten the rest of the spoke nipples one turn at a time until they are snug.
5. Seat each spoke head in the hub flange using a flat nose punch and mallet. Then check wheel trueness again and tighten the nipples accordingly.




**1. Offset: 0.890-0.910 in.**
**2. Hub on 19 in. front spoke VRSCX**

**Figure 2-80. Laced Hub Offset Dimension**

**⚠WARNING**

**Spokes that are too tight can draw nipples through the rim or distort hub flanges. Spokes that are too loose can continue to loosen when put in service. Either condition can adversely affect stability and handling, which could result in death or serious injury. (00286a)**

6. Verify spokes are tightened to 6.2 Nm (55 **in-lbs**) minimum.
7. File or grind off ends of spokes protruding through nipples to prevent puncturing tube when tire is mounted.

*NOTE*

*After installation of front wheel, visually check the relationship of the front wheel to the fork fender bosses. The front wheel should be approximately centered between the bosses.*

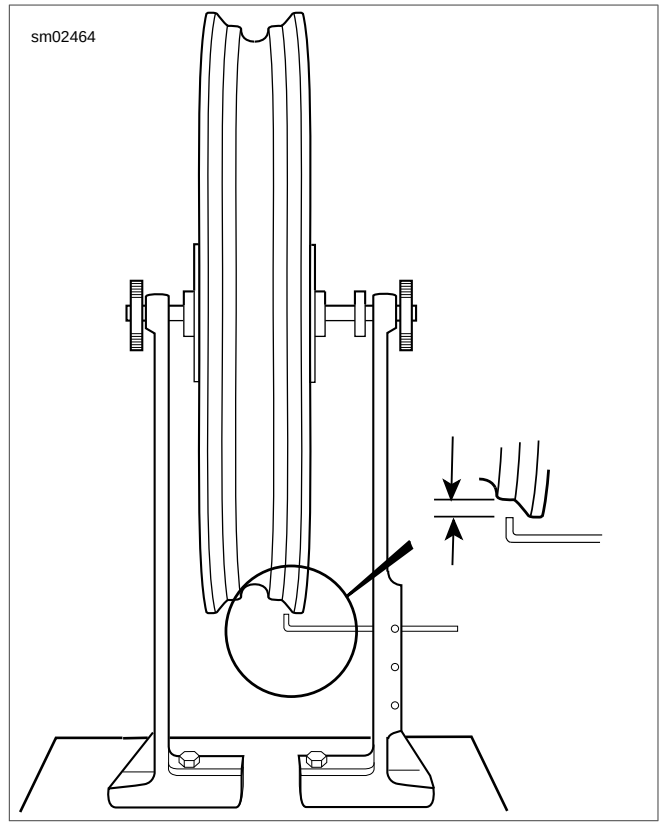



**Figure 2-81. Truing Rim Radially**

## GENERAL

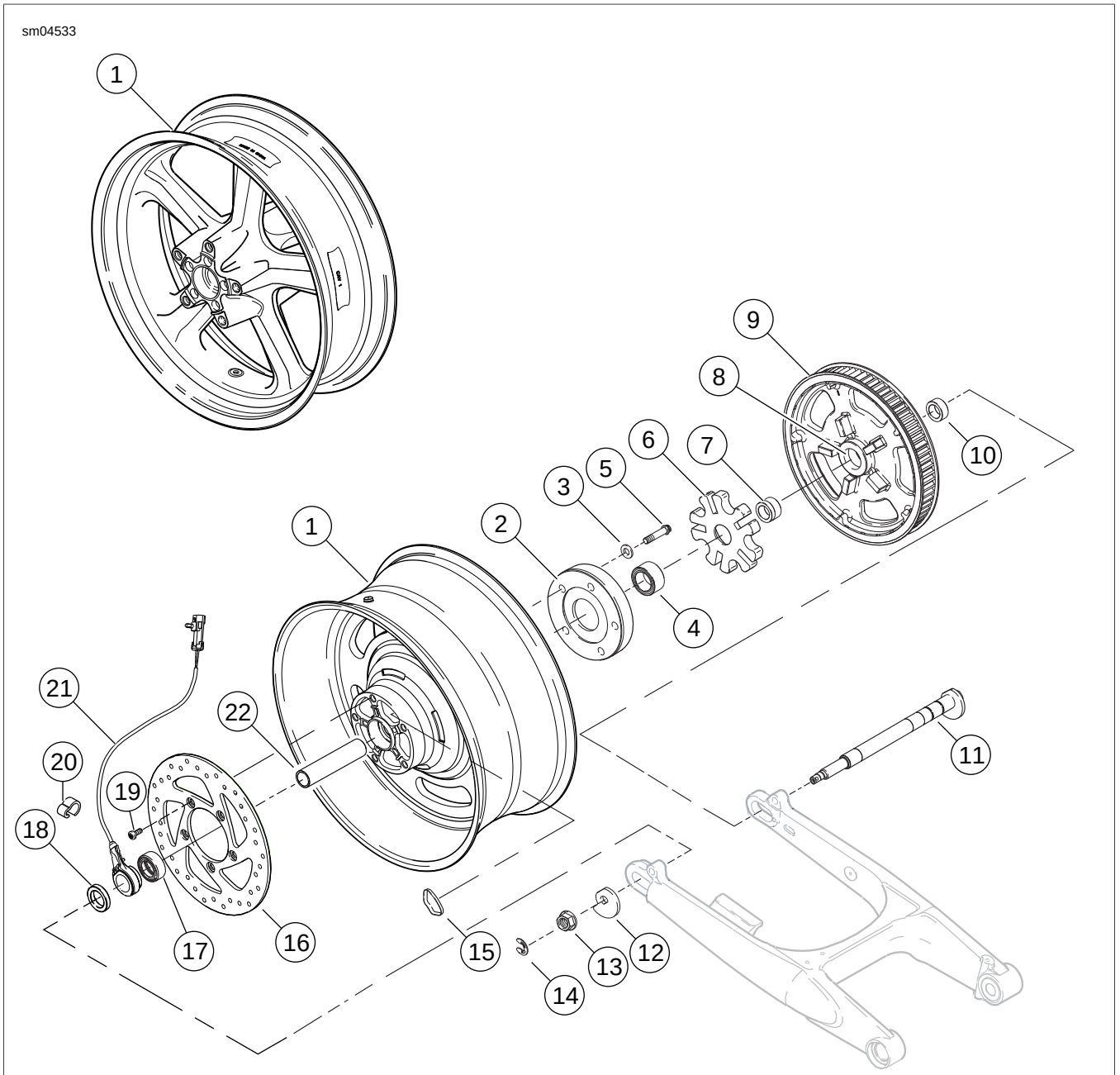
Maximum tire mileage and good handling qualities are directly related to care given wheels and tires. Wheels and tires should be inspected regularly for wear. If handling problems occur, see 1.30 TROUBLESHOOTING for possible causes.

### Preliminary Inspection - Brake Disc

1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
2. Replace disc if warped. Maximum allowable runout of a rear brake disc is 0.3 mm (0.012 in.).
3. If scored, replace disc.

### Preliminary Inspection - Wheel/Tire

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect tire for wear and wear pattern. Remove wheel assembly and replace tire as necessary. See 2.30 TIRES.
3. Inspect air valve. Replace as necessary.
4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See 2.28 SEALED WHEEL BEARINGS.




1. **Wheel (optional wheels shown)**
2. **Compensator bowl**
3. **Lockwasher (5)**
4. **Bearing (1 - ABS left side, 2 - NON-ABS right and left)**
5. **Screw (5)**
6. **Cushion compensator**
7. **Spacer**
8. **Bearing**
9. **Sprocket**
10. **Spacer - ABS**
11. **Axle**
12. **Rear axle adjuster**
13. **Nut**
14. **E-Clip**
15. **Plug (solid disc only) (5)**
16. **Brake disc**
17. **Bearing - ABS (right)**
18. **Spacer, wheel bearing**
19. **Screw (5)**
20. **Clip (4)**
21. **Wheel Speed Sensor - ABS**
22. **Sleeve Bearing**

**Figure 2-82. Rear Wheel Components (typical)**

## REMOVAL

1. Block motorcycle underneath frame so weight of motorcycle is off of rear wheel.

*NOTE*

*A scissors style jack will allow you to raise or lower the motorcycle at different points throughout the procedure to provide both clearance and alignment during removal and installation.*

2. Remove right side cover and maxi-fuse.
3. See Figure 2-83. Remove fasteners holding lower debris deflector (4) to Swingarm. Remove debris deflector.
4. If necessary, remove fasteners holding belt guard (1) to Swingarm. Back lower shock bolt (2) out until belt guard is free and remove belt guard. Shock bolt retaining threads are integral to belt guard. Leave shock bolt in place to maintain alignment.
5. See Figure 2-84. Remove snap ring (2), axle nut (1) and adjuster (4) from right side of axle.
6. Relieve belt tension by rotating axle adjusters.

*NOTES*

- *Support rear tire from underneath during removal. Failure to support rear tire may cause damage to the motorcycle as the axle is removed.*
- *If ABS equipped, carefully remove clips connecting ABS cable to brake hose.*
- *If ABS equipped, never pull wheel speed sensor cable taut, or use to retain wheel, axle, or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

7. Tap axle towards left side until rear brake caliper is free.
8. Slide rear caliper up off of brake disc towards front of motorcycle. Using a bungee cord, secure caliper to right side shock. Be sure rubber bumper stays with caliper.
9. Remove axle. Identify and set aside right and left spacers, right side axle adjuster, axle nut, and snap ring and ABS wheel speed sensor and ABS encoder bearing (if ABS equipped).

*NOTE*

*Polished aluminum and painted wheels can be scratched or damaged when slid out of and into the Swingarm. Exercise caution to avoid dragging wheel and sprocket surfaces against Swingarm components.*

10. Move wheel forward and slip belt off sprocket. Adjust height of the scissors jack to allow removing wheel assembly without damaging components.

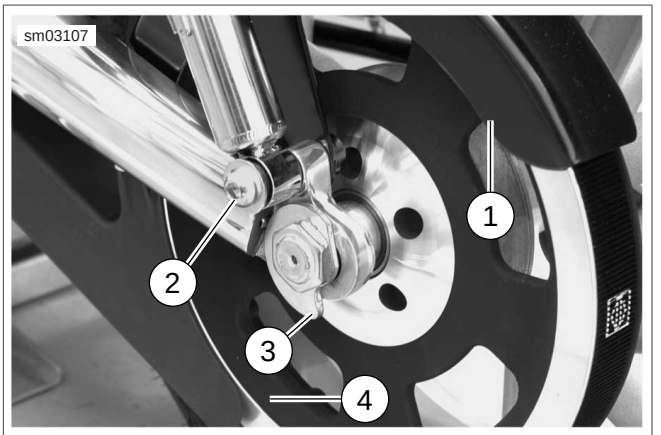
*NOTE*

*Note the height of the license plate bracket. Pulling the rear wheel can break off the reflector brackets.*

11. Pull wheel and drive belt sprocket assembly from Swingarm.

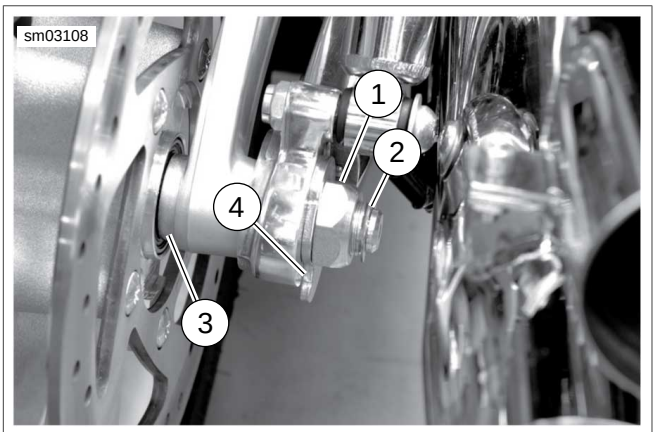
*NOTE*

*Do not operate rear brake pedal with the rear wheel removed or the caliper piston may be forced out of piston bores. Reseating the piston requires disassembly of the caliper.*




1. **Belt guard**
2. **Lower shock bolt**
3. **Left side axle adjuster**
4. **Debris deflector**

**Figure 2-83. Rear Axle: Left Side (typical)**




1. **Axle nut**
2. **Snap ring**
3. **Right side spacer**
4. **Right side axle adjuster**

**Figure 2-84. Rear Axle: Right Side (typical)**

## DISASSEMBLY

1. See Figure 2-85. Pull sprocket out of rubber compensator cushion (1) and compensator bowl (4) mounted to disc wheel.
2. Pull compensator spacer (2) and compensator cushion (1) from compensator bowl (4) mounted to disc wheel.
3. If tire replacement is necessary, remove tire and valve stem. See 2.30 TIRES.

*NOTE*

*If drive sprocket bearing surface is rough or if bearing is leaking grease, replace bearing in according to procedure. See 2.27 REAR WHEEL, Cleaning and Inspection.*

4. See Figure 2-82. If necessary, remove screws (5) and lockwashers (3) holding compensator bowl (2) to disc wheel (1). Remove compensator bowl (3).

5. If necessary, remove fasteners (19) that hold brake disc (16) to disc wheel (1) and remove brake disc (16).

## CLEANING AND INSPECTION

1. Thoroughly clean all parts (except wheel bearings, or wheel speed sensor if ABS equipped) in solvent. Wipe bearings or ABS sensors with damp cloth and inspect for wear.

*NOTE*

*The wheels are aluminum and do not have a protective coating. Damage from harsh chemicals, acid based wheel cleaners, brake dust and lack of maintenance can occur. Use Harley-Davidson Wheel and Tire Cleaner (Part No. 94658-98) to clean the wheels and tires and then use Harley Gloss (Part No. 94627-98) to protect the aluminum wheel surfaces.*

2. Inspect rear belt. See 1.17 REAR BELT AND SPROCKETS.
3. Inspect sprocket bearing. If bearing surface is rough or if bearing was leaking grease, replace sprocket bearing as follows:
   a. Supporting hub inside compensator dogs. use a suitable drift to press bearing out of sprocket hub.
   b. Lubricate the bearing bore in the sprocket hub.
   c. Supporting hub from cosmetic side in such a manner as to not damage machined surface, use a suitable drift to press in a **new** bearing. To avoid damaging bearing, drift should press on outside race of bearing.
4. Inspect compensator cushion for missing chunks or excessive debris beyond normal wear marks. Replace if necessary.
5. Inspect brake disc. Replace disc if warped or badly scored. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
6. If sealed wheel bearings must be serviced, see 2.28 SEALED WHEEL BEARINGS

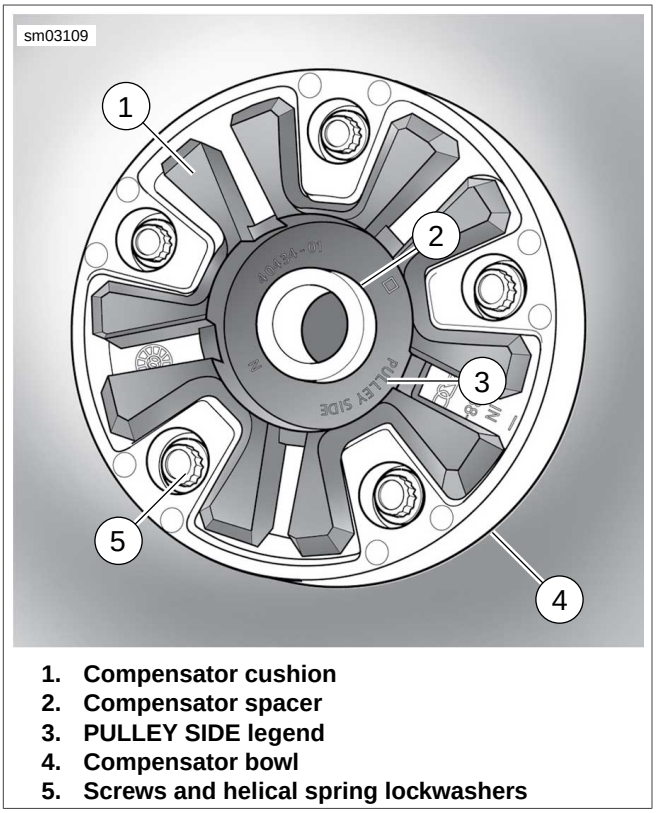
**⚠WARNING**

**Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)**

7. Inspect brake pads, calipers, and brake lines. Replace pads and service calipers and brake lines as required. See 1.11 BRAKE PADS AND DISCS.

## ASSEMBLY

1. If necessary, mount tire, valve stem and balance wheel assembly as required. See 2.30 TIRES.
2. Install brake disc, if removed, on valve stem side of wheel.
   a. Apply a drop of LOCTITE® 242 to the five bolts that hold on rear brake disc.
   b. Thread in and alternately tighten to 41-53 Nm (30-38 ft-lbs) .
3. Install compensator bowl. Thread in screws and helical spring lockwashers. Tighten to 61-75 Nm (45-55 ft-lbs) .
4. Verify that wheel and tire are true and balanced. See 2.29 DISC RIM RUNOUT and 2.30 TIRES.
5. After wheel is balanced, apply LOCTITE® ANTI-SEIZE LUBRICANT to entire surface of left side (compensator bowl) bearing race only.
6. See Figure 2-85. Lubricate compensator cushion (1) with a detergent spray like glass cleaner and install compensator cushion. Be sure the PULLEY SIDE legend (3) is facing out.
7. Install the compensation spacer (2) with the grooved end in the cushion (1).
8. Insert sprocket dogs into compensator cushion to mate sprocket to rear wheel.




1. **Compensator cushion**
2. **Compensator spacer**
3. **PULLEY SIDE legend**
4. **Compensator bowl**
5. **Screws and helical spring lockwashers**

**Figure 2-85. Compensator Cushion in Compensator Bowl (typical)**

## INSTALLATION

1. Install wheel into swingarm.
2. Slide drive belt over drive sprocket.
3. Slide brake calipers over front brake disc between brake pads. Lubricate rubber bumper with a detergent spray and slide slot in the caliper over brake anchor weldment on swingarm. Be sure rubber bumper is in place under weldment.

4. Apply a light coat of LOCTITE® ANTI-SEIZE LUBRICANT to axle, bearing bores, bore of left spacer, bore of brake caliper mount, and bore of inner sleeve.
   a. From left side, carefully insert axle through swingarm, left side spacer, drive sprocket, compensator cushion, into wheel assembly.
   b. Continue sliding axle through wheel assembly hub sleeve, right side spacer, brake caliper, and left swingarm. Center right side spacer on wheel bearing to allow axle to pass through. Axle is fully installed when left side cam is tight against swingarm.
   c. Slip on right side axle adjuster. Right side axle adjuster will only fit in a manner that matches position of left side eccentric.
   d. Coat flange of axle nut with LOCTITE® ANTI-SEIZE LUBRICANT and thread on and finger tighten axle nut.

**⚠WARNING**

**Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)**

*NOTE*

- *If ABS equipped, never pull wheel speed sensor cable tight or use to retain wheel, axle or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

5. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
6. Verify axle alignment and then check belt deflection. See 1.16 REAR BELT DEFLECTION.
7. Use a wrench to rotate rear axle adjuster until drive belt deflection is within specifications.

**⚠WARNING**

**Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)**

8. Tighten axle nut to 190-203 Nm (140-150 ft-lbs).
9. Install snap ring.
10. If belt guard was removed, slide belt guard slots onto rubber grommets. Install shock mount bolt into belt guard. See 2.37 REAR SHOCK ABSORBERS.
11. Slide debris deflector slots on to its corresponding rubber grommet. Install debris deflector bolt and tighten bolt to 6-10 Nm (53-88 **in-lbs**).
12. Measure belt guard to drive sprocket clearance.
13. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.
14. Install maxi-fuse and right side cover.

## GENERAL

Inspection for lateral end play, removal, and installation procedures for sealed wheel bearings are the same for both the front wheel and the rear wheel.

## INSPECTION: LATERAL END PLAY

1. Block motorcycle underneath frame so wheel is raised off ground.

*NOTE*

*If ABS equipped, keep magnetic base dial indicator as far away from wheel speed sensor and ABS encoder bearing as possible, or damage will occur.*

2. See Figure 2-86. Mount a magnetic base dial indicator to brake disc with dial's contact point on end of axle.

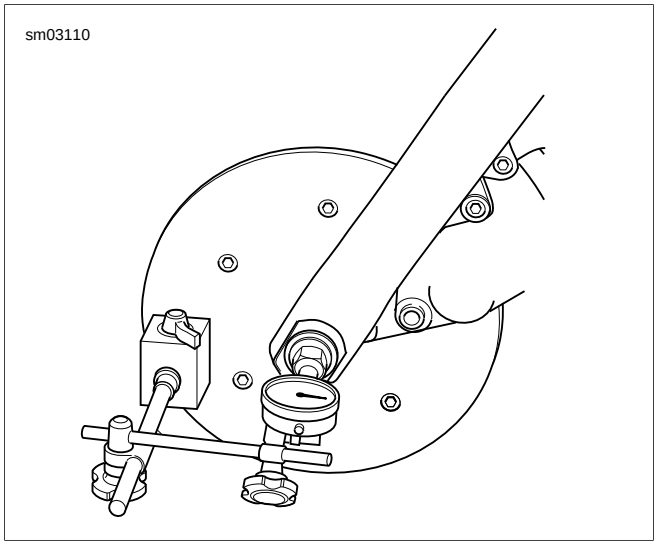



**Figure 2-86. Measuring Lateral End Play (Front Wheel) (typical)**

3. To check for lateral end play, turn wheel through several rotations, then move wheel side to side.
   a. If end play is less than service wear limit of 0.051 mm (.002 in.), bearing passes inspection.
   b. If end play exceeds service wear limit or feels rough, remove wheel and replace both wheel bearings.

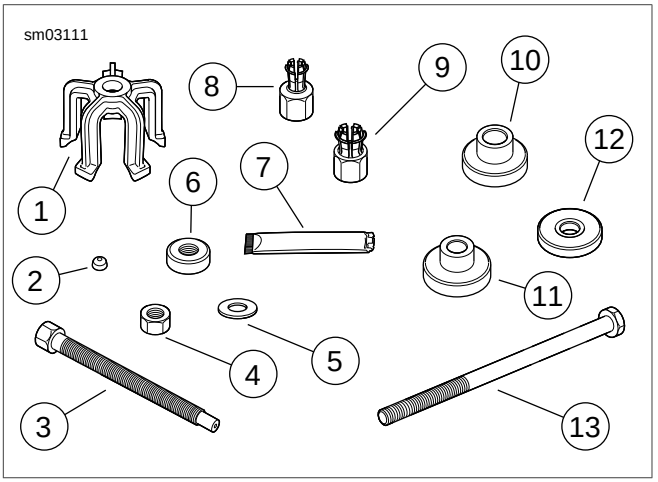



**Figure 2-87. HD-44060 Wheel Bearing Tools (See Table)**

**Table 2-10. HD-44060 Wheel Bearing Tools**

| NO. | DESCRIPTION | PART NO. |
|---|---|---|
| 1 | Bridge | HD-44060-5 |
| 2 | Steel ball | 12547 |
| 3 | Forcing screw | HD-44060-4 |
| 4 | Nut | 10210 |
| 5 | Washer | 12004 |
| 6 | Bearing | RS25100-200 |
| 7 | Lubricant | J-23444A |
| 8 | Collet, 3/4 in. | HD-44060-3 |
| 9 | Collet, 1.0 in. | HD-44060-7 |
| 10 | Pilot, 1.0 in. | HD-44060-8 |
| 11 | Pilot, 3/4 in. | HD-44060-6 |
| 12 | Support plate | HD-44060-1 |
| 13 | Threaded rod | 280856 |
| **Parts 1-7 common to removal/installation.** | | |
| **Parts 8-9 used for removal only.** | | |
| **Parts 10-13 used for installation only.** | | |

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-44060 | WHEEL BEARING INSTALLER/REMOVER |

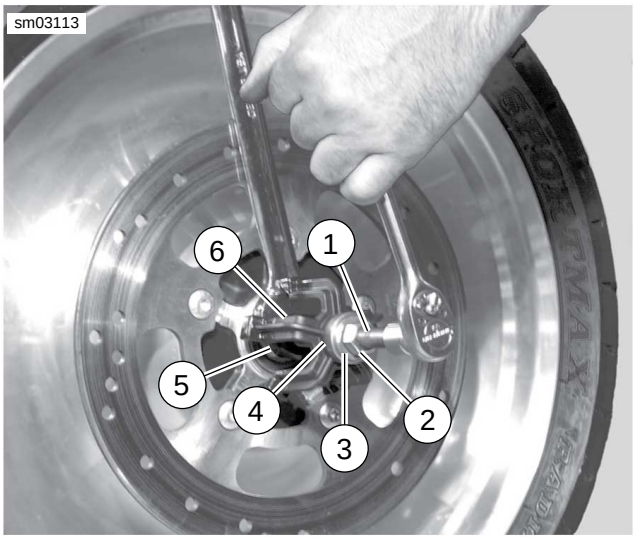
1. Remove wheel. See 2.27 REAR WHEEL and 2.24 FRONT WHEEL.

2. See Figure 2-88. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble tools required for bearing removal.
   a. Sparingly apply graphite lubricant to threads of forcing screw (1) to prolong service life and ensure smooth operation.
   b. Install nut (2), washer (3) and bearing (4) on screw. Insert assembly through hole in bridge (6).

*NOTE*

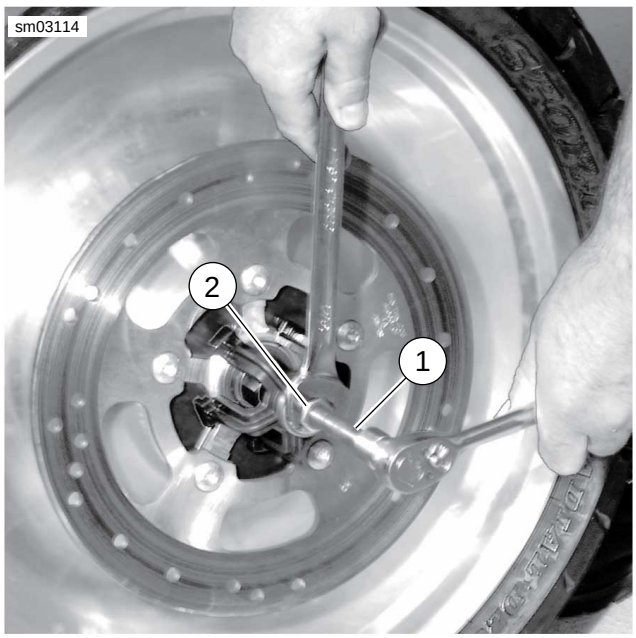
*As ABS equipped motorcycles use both a special encoder bearing and a standard bearing in the same hub, two different 25 mm collets are required for bearing removal. The ABS encoder bearing is always installed on the primary brake disc side of the wheel. To aid in identification, the outboard side of the ABS encoder bearing is greenish tan in color, while the standard bearing is black.*

   c. Drop ball bearing inside collet (5). Fasten collet and ball bearing to forcing screw (1).
3. Hold end of forcing screw (1) and turn collet (5) to expand edges of collet.
4. See Figure 2-89. When expanded collet has gripped bearing edges, hold end of forcing screw (1) and turn nut (2) to remove bearing from wheel.
5. If ABS encoder bearing was removed from primary brake disc side of wheel, remove ABS collett from forcing screw and install standard collett.
6. Remove spacer from inside wheel hub.
7. Repeat procedure for opposite side bearing. Discard all bearings upon removal.




1. **Forcing screw**
2. **Nut**
3. **Washer**
4. **Nice bearing**
5. **Collet with ball bearing inside**
6. **Bridge**

**Figure 2-88. Gripping Bearing (typical)**




1. **Forcing screw**
2. **Nut**

**Figure 2-89. Removing Bearing (typical)**

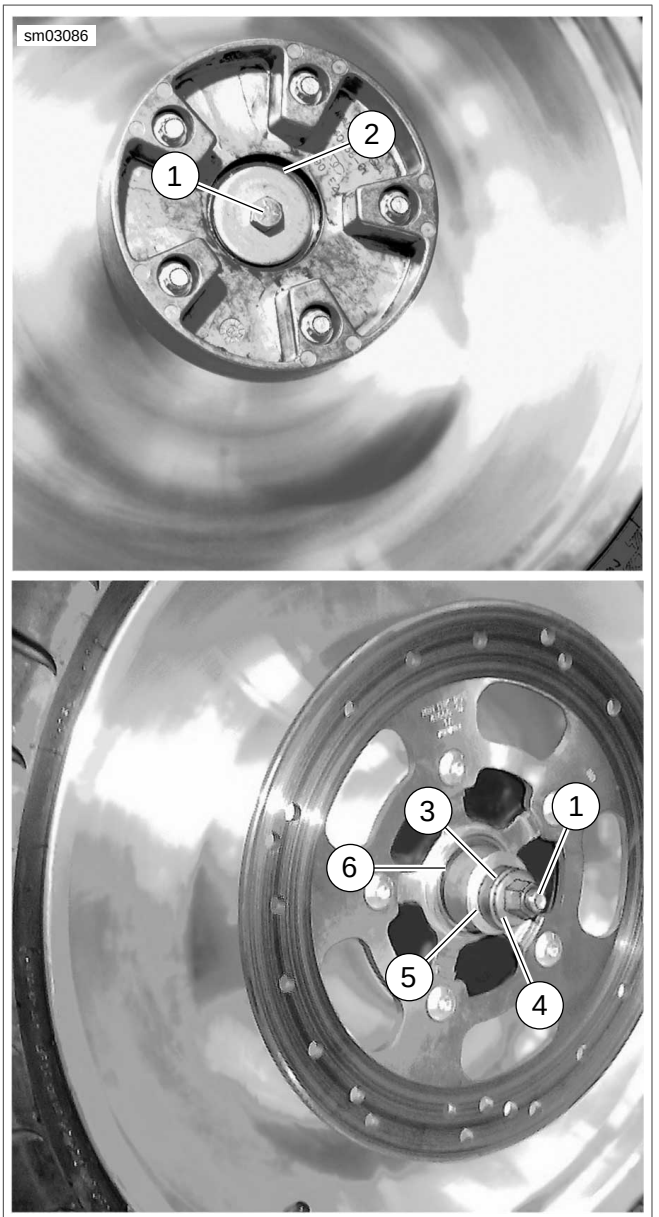
## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-44060 | WHEEL BEARING INSTALLER/REMOVER |

*NOTES*

- *On a front wheel, install bearing on the left side first. On a rear wheel, install bearing on the brake disc or right side first. On ABS equipped motorcycles, the special encoder bearing is always installed at this location.*
- *As ABS equipped motorcycles use both a special encoder bearing and a standard bearing in the same hub, two different 25 mm collets are required for bearing removal. The ABS encoder bearing is always installed on the primary brake disc side of the wheel. To aid in identification, the outboard side of the ABS encoder bearing is greenish tan in color, while the standard bearing is black.*

1. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble tools required for bearing installation.
   a. Sparingly apply graphite lubricant to threads of a draw down bolt or a suitable threaded rod with double locking nuts to prolong service life and ensure smooth operation.
   b. See Figure 2-90. Place threaded rod (1) through support plate (2).
   c. Insert assembly through wheel.
   d. Place the **new** bearing on threaded rod (1) with lettered side outward. If ABS equipped, slide encoder bearing down rod with red-side in and greenish tan-side out.
   e. Install pilot (6), bearing (5), washer (4) and nut (3) over rod.
2. Hold hex end of threaded rod (1) and turn nut (3) to install bearing. Bearing will be fully seated when nut can no longer be turned. Remove tool.
3. Install spacer sleeve inside wheel hub.
4. Reverse tool and install opposite side bearing.




1. **Threaded rod**
2. **Support plate**
3. **Nut**
4. **Washer**
5. **Nice bearing**
6. **Pilot**

**Figure 2-90. Installing Wheel Bearing (typical)**

## GENERAL

Disc wheels should be checked for lateral and radial runout before installing a **new** tire or tube.

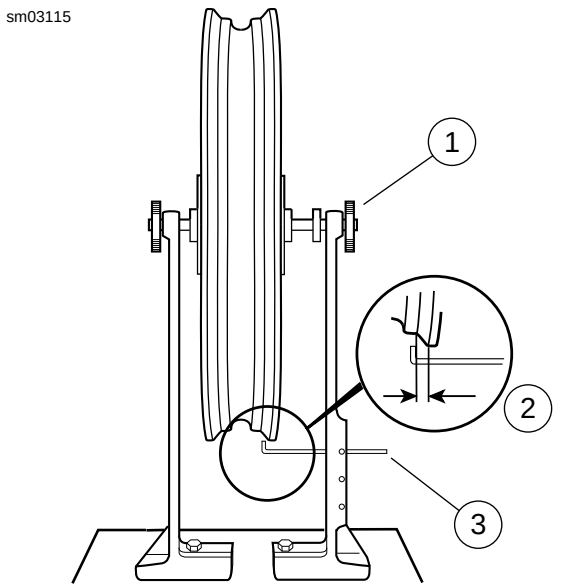
**Table 2-11. Rim Runout Maximums**

| RUNOUT | MM | IN |
|---|---|---|
| Lateral | 0.76 | 0.030 |
| Radial | 0.76 | 0.030 |

## LATERAL RUNOUT

| PART NUMBER | TOOL NAME |
|---|---|
| HD-95599-80 | WHEEL TRUING STAND |

See Figure 2-91. Install arbor in wheel hub and place wheel in WHEEL TRUING STAND (Part No. HD-95599-80) . To check rim lateral runout, place a gauge rod or dial indicator near rim bead. Spin wheel. If lateral runout exceeds 0.76 mm (0.030 in.), replace wheel.




1. **Wheel truing and balancing stand**
2. **Lateral runout**
3. **Gauge rod**

**Figure 2-91. Checking Cast Wheel Lateral Runout**

## RADIAL RUNOUT

See Figure 2-92. Spin wheel to check for radial runout. Replace wheel if rim radial runout exceeds 0.76 mm (0.030 in.).

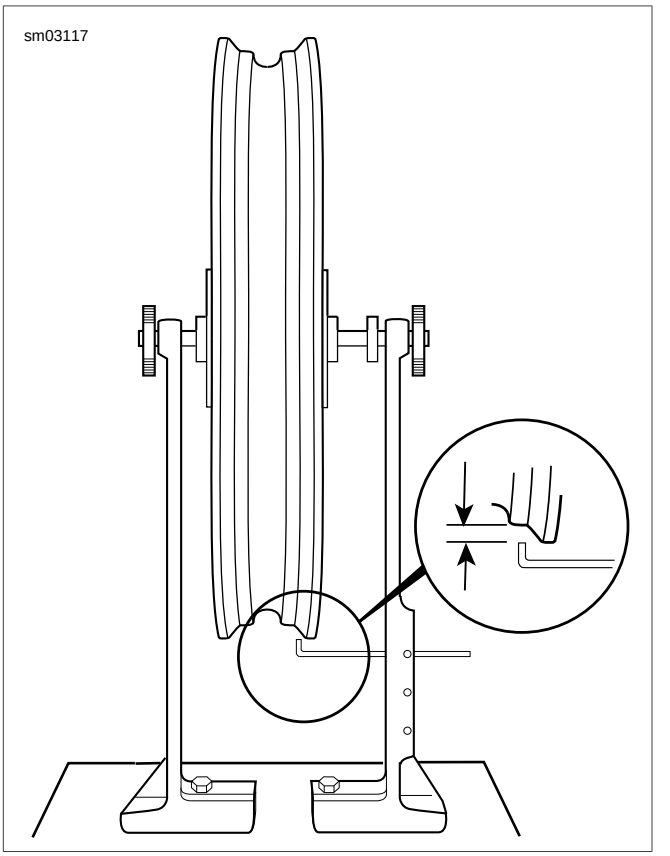



**Figure 2-92. Rim Radial Runout**

## GENERAL

**WARNING**

**Use only Harley-Davidson approved tires. See a Harley-Davidson dealer. Using non-approved tires can adversely affect stability, which could result in death or serious injury. (00024a)**

**WARNING**

**Be sure tires are properly inflated, balanced and have adequate tread. Inspect your tires regularly and see a Harley-Davidson dealer for replacements. Riding with excessively worn, unbalanced or under-inflated tires can adversely affect stability and handling, which could result in death or serious injury. (00014a)**

New tires should be stored on a horizontal tire rack. Avoid stacking new tires in a vertical stack. The weight of the stack compresses the tires and closes down the beads.

Tires should be inspected for punctures, cuts, breaks and wear at least weekly.

## REMOVAL

*NOTE*

*Care must be taken when removing and installing tire to prevent cosmetic damage to wheel. This is especially true with wheels that feature painted surfaces.*

1. Remove wheel from motorcycle. See 1.13 TIRES AND WHEELS.
2. Deflate tire.
3. See Figure 2-93. Loosen both tire beads from rim flange. In most cases, a bead breaker machine will be required to loosen the beads from the rim.
4. Remove tire.

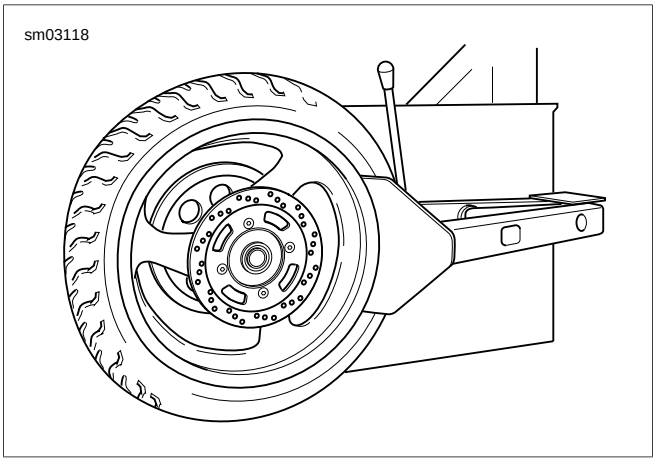



**Figure 2-93. Loosening Beads from Rim Flange (Typical)**

## CLEANING, INSPECTION, AND REPAIR

1. Clean the inside of tire.
2. If rim is dirty, clean with a stiff wire brush.
3. Wheels should be checked for lateral and radial runout before installing a **new** tire. See 2.29 DISC RIM RUNOUT.
4. Inspect the tire for wear and damage. Inspect tread depth. Replace worn tires.

**WARNING**

**Replace punctured or damaged tires. In some cases, small punctures in the tread area may be repaired from within the demounted tire by a Harley-Davidson dealer. Speed should NOT exceed 50 mph (80 km/h) for the first 24 hours after repair, and the repaired tire should NEVER be used over 80 mph (130 km/h). Failure to follow this warning could result in death or serious injury. (00015a)**

5. Tubeless tires may be repaired in the tread area only if the puncture is 6.4 mm (1/4 in.) or smaller. All repairs must be made from inside the tire.
6. Acceptable repair method involves the use of a patch and plug combination.

## TIRE REPLACEMENT

### Inspection

**WARNING**

**Harley-Davidson tires are equipped with wear bars that run horizontally across the tread. When wear bars become visible and only 1/32 in. (0.8 mm) tread depth remains, replace tire immediately. Using a worn tire can adversely affect stability and handling, which could result in death or serious injury. Use only Harley-Davidson approved replacement tires. (00090b)**

See Figure 2-94. Arrows on tire sidewalls pinpoint location of wear bar indicators.

Tread wear indicator bars will appear on tire tread surfaces when 0.8 mm (1/32 in.) or less of tire tread remains. See Figure 2-95. Always replace tires before the tread wear indicator bars appear.

### When To Replace Tires

New tires are needed if any of the following conditions exist:

1. Tread wear indicator bars become visible on the tread surfaces.
2. Tire cords or fabric become visible through cracked sidewalls, snags or deep cuts.
3. A bump, bulge or split in the tire.
4. Puncture, cut or other damage to the tire that cannot be repaired.

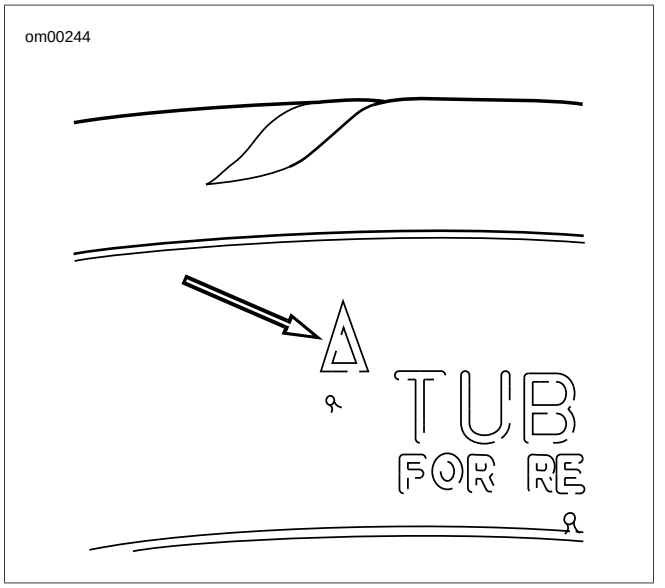



**Figure 2-94. Tire Sidewall: VRSC Models**

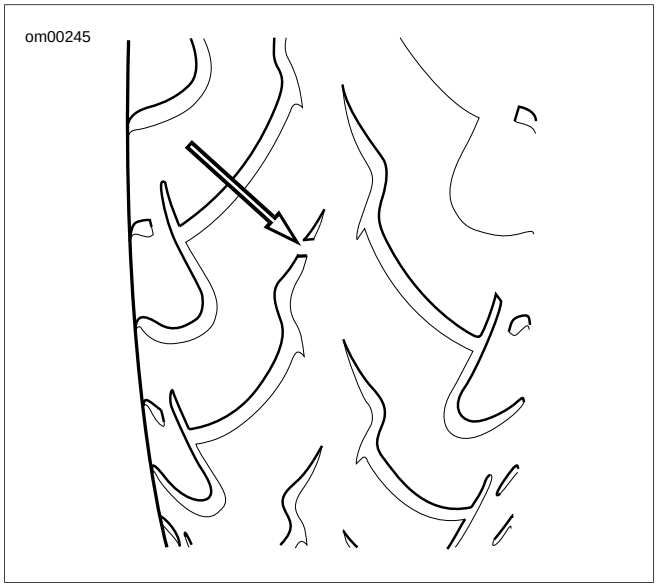



**Figure 2-95. Tread Surface Wear Bar (Typical): VRSC Models**

## INSTALLATION

**WARNING**

**Match tires, tubes, air valves and caps to the correct wheel rim. Contact a Harley-Davidson dealer. Mismatching can result in damage to the tire bead, allow tire slippage on the rim or cause tire failure, which could result in death or serious injury. (00023a)**

**WARNING**

**Harley-Davidson front and rear tires are not the same. Interchanging front and rear tires can cause tire failure, which could result in death or serious injury. (00026a)**

**WARNING**

**Do not exceed manufacturer's recommended pressure to seat beads. Exceeding recommended bead seat pressure can cause tire rim assembly to burst, which could result in death or serious injury. (00282a)**

**WARNING**

**Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)**

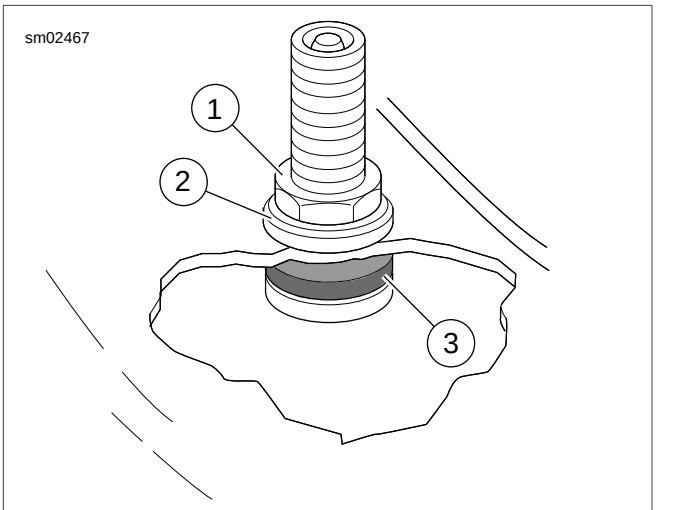
*NOTES*

- *For correct tire and tube types, see 2.1 SPECIFICATIONS: CHASSIS.*
- *Some tires have arrows molded into the tire sidewall. These tires should be mounted on the rim with the arrow pointing in the direction of forward rotation. The colored dot on the sidewall is a balance mark and should be located next to the valve stem hole.*

**WARNING**

**Only install original equipment tire valves and valve caps. A valve, or valve and cap combination, that is too long or too heavy can strike adjacent components and damage the valve, causing rapid tire deflation. Rapid tire deflation can cause loss of vehicle control, which could result in death or serious injury. (00281a)**

1. See Figure 2-96. On tubeless wheels, damaged or leaking valve stems must be replaced. Install rubber grommet (3) on valve stem.
2. Insert valve stem into rim hole.
3. Install metal washer (2).
4. Install nut and tighten to 1.4-1.7 Nm (12-15 **in-lbs**).
5. Install tire.




1. **Nut**
2. **Metal washer**
3. **Rubber grommet**

**Figure 2-96. Tubeless Tire Valve Stem**

## GENERAL

The alignment of the front wheel to the rear wheel is set at the factory. There are no adjustments for alignment. Alignment is maintained with quality components and with correct assembly procedures.

The stabilizer link between the engine and the frame is a horizontal engine locator only. The stabilizer link is **not** to be used to adjust the horizontal alignment of the rear wheel. See 2.5 FRONT ENGINE MOUNT ASSEMBLY.

Verification of front wheel to rear wheel alignment can be used to determine the cause of an ill-handling motorcycle or of a vibration/noise in the front engine mount.

## INSPECTION

Before following the verification procedure, after engine removal and replacement, or after service that requires removing and replacing the front motor mounts or the Swingarm and engine mounts, always inspect the front and rear engine mounts, the stabilizer link, the rear tire to the fender mounting hardware clearance and the lower left crankcase to frame rail clearance.

### Front Engine Mount

1. Verify condition and torque of the front engine mount. Visually inspect for wear, damage or improper installation. Replace hardware as necessary.
2. Replace the rubber mount if there are any signs of bulging, cracking, or shearing. See 2.4 FRONT ENGINE MOUNT.

### Rear Engine Mounts and Swingarm Pivot

1. Verify condition and torque of the mounting hardware. Visually inspect for wear, damage or improper installation. Replace hardware as necessary.
2. Examine rubber rear engine mounts to be sure there is no twisting or binding. Replace as required. See 2.6 REAR ENGINE MOUNTS.

### Engine Stabilizer Link

1. Verify condition and torque of the mounting hardware.
2. Visually inspect for wear, damage or improper installation. Replace hardware as necessary. See 2.5 FRONT ENGINE MOUNT ASSEMBLY.

### Clearances

1. The rear wheel and tire must have adequate clearance through its suspension travel.
2. The engine crankcase should have a minimum 3.18 mm (0.125 in.) clearance from the lower left hand frame rail.

## VERIFICATION

**⚠WARNING**

**Check vehicle alignment according to following procedures. Incorrect alignment can adversely affect stability and handling, which could result in death or serious injury. (00287a)**

1. Verification of wheel alignment requires that the motorcycle meet specifications for the following components:
   a. Wheels. See 2.29 DISC RIM RUNOUT.
   b. Tires. See 1.13 TIRES AND WHEELS.
   c. Steering head bearing "fall-away." See 1.21 STEERING HEAD BEARINGS.
   d. Belt deflection. See 1.16 REAR BELT DEFLECTION.
2. Place the motorcycle on a center stand to support the vehicle and lift the rear wheel off the ground.
   a. Place scissors jack under fuel tank mount with clearance for alignment bars.
   b. Do **NOT** support engine on oil sump. The engine must be free to shift slightly in its mounts.
   c. Be sure the motorcycle is as level as possible.
3. Identify the rear tire clearance to the rear fender and mounting hardware. The tire should appear to be centered and move through its travel without hitting other components.
4. Install a set of straightedges or alignment bars on both the left and right side of motorcycle alongside the front and rear tires.
   a. Both alignment bars should firmly contact the rear tire at two points on both sides of the tire.
   b. Use clamps or bungee cords to hold the bars in place. Tension should be equal to avoid spreading or pinching the bars.
   c. Verify that the bars are parallel by comparing the measurements between the bars at both ends.
5. See Figure 2-97. Straighten the front forks. From the front wheel rim, measure to the bar on one side of the motorcycle at the rear of the rim (A) and at the front of the rim (B) (two points). Straighten the front forks until the two measurements are equal (A = B).
6. See Figure 2-98. Measure vertical alignment by placing an inclinometer vertically on front and rear brake discs. Front and rear lean angles should be equal within +/- 1/2 degree.
7. See Figure 2-97. On the other side of the motorcycle, measure from the alignment bar to the front wheel rim (C) and compare measurement to that of the opposite side (B - C).
   a. If opposing side measurements (B - C) are within +/- 6.35 mm (0.250 in.), the front and rear wheel are in alignment.
   b. If the difference in opposing side measurements (B - C) is more than +/- 6.35 mm (0.250 in.), the front and rear wheel are out of alignment.

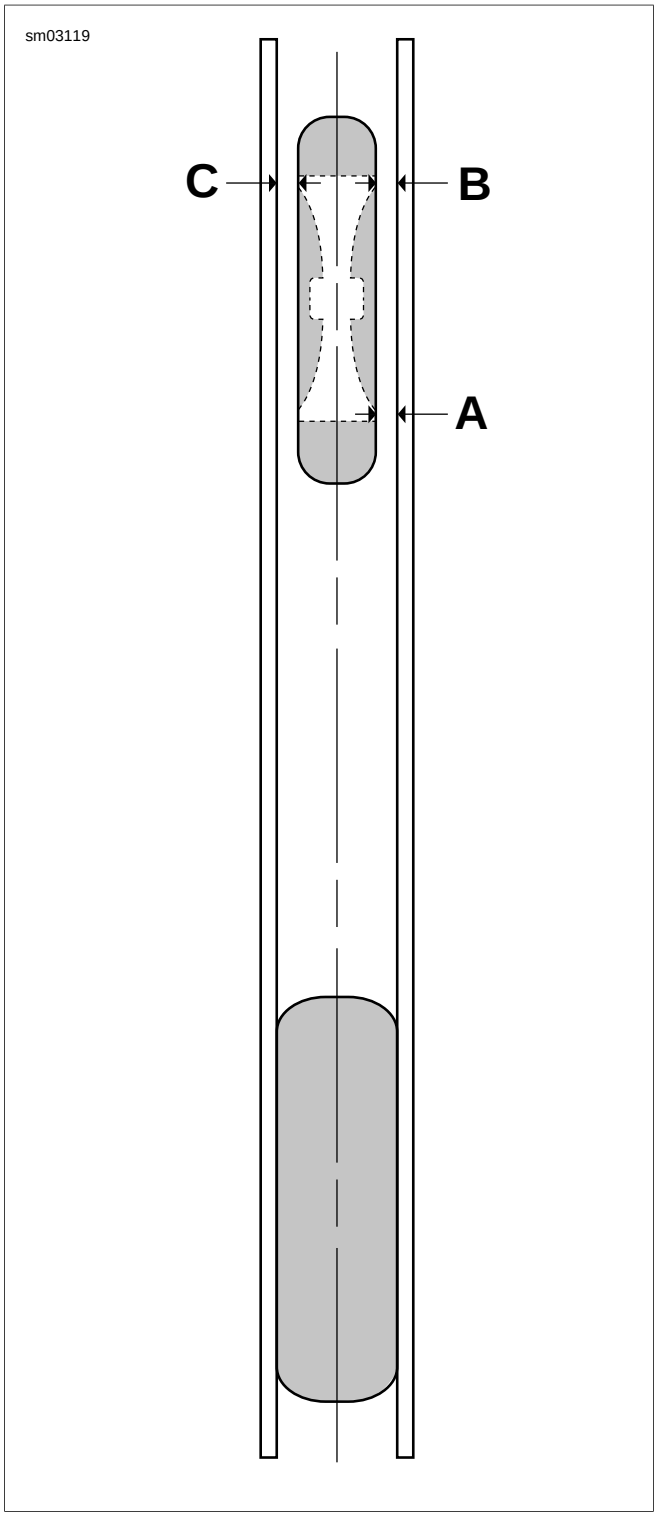



**Figure 2-97. Wheel Alignment: When A = B and the Difference Between B and C is Less than +/- 6.35 mm (0.250 in.), the Front Wheel is Aligned to the Rear.**

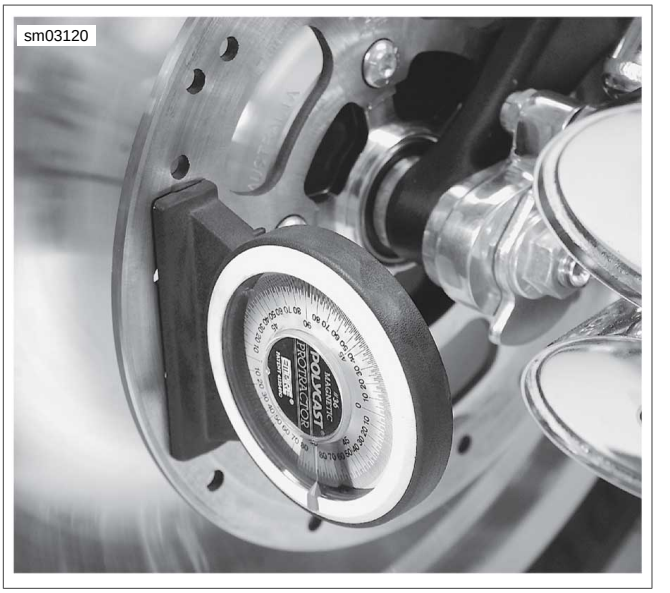



**Figure 2-98. Measuring Vertical Alignment (typical)**

## CENTERING ENGINE

1. Verify wheel alignment. See 2.31 WHEEL ALIGNMENT.
2. See Figure 2-99. If the front and rear wheels are out of alignment, loosen and remove the engine stabilizer link from the tab on the frame. This allows the engine to center itself to the front and rear engine mounts.
3. Repeat alignment verification:
   a. See Figure 2-97. To straighten the front wheel, measure from the front wheel rim to the bar on one side at two points (A, B) along the wheel rim. Straighten the front wheel until the measurements are the same (A = B).
   b. Measure the front and rear brake disc vertical lean angles. The angles should be within +/- 1/2 degree.
   c. On the other side, measure the from the rim to the bar (C) and compare (B - C) to the measurement from the opposite side. The measurements must be within +/- 6.35 mm (0.250 in.).
   d. Check the left lower engine case to frame rail clearance. It should be at least 3.18 mm (0.125 in.).
   e. Identify clearance between the rear tire and the rear fender mounting hardware. The tire should appear to be centered and move through its suspension travel without hitting other components.

*NOTE*

*Lengthening or shortening the stabilizer link can put stress on the crankcase mounting boss. The stress may break or crack the crankcase mounting boss after light impact.*

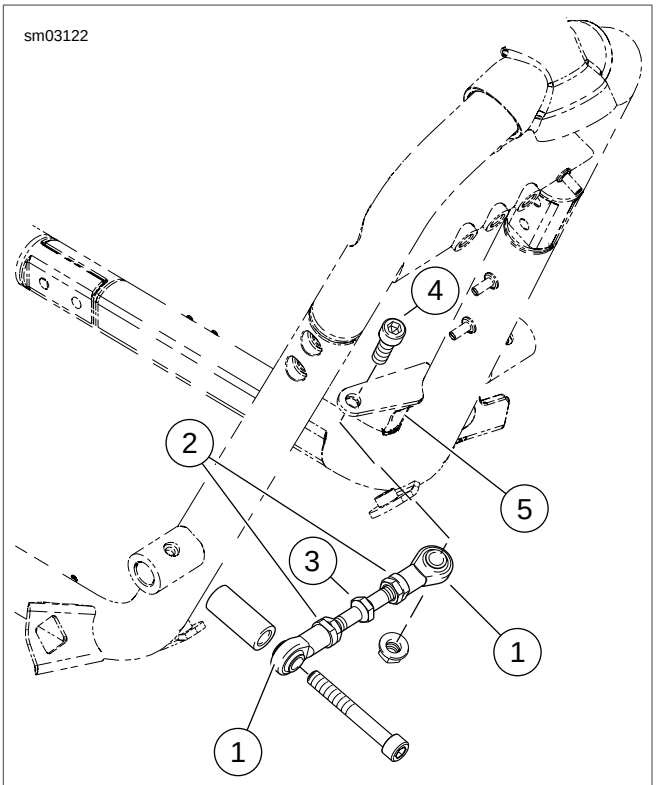
4. See Figure 2-99. The stabilizer link fastener (4) should fit freely through the ball end of the link (1) and the frame tab (5). If it does not, loosen lock nuts (2) on the ball ends (1) and use adjusting nut (3) and rod to adjust length of stabilizer link until stabilizer link bolt fits freely through ball end (1) of stabilizer link and frame tab (5).

5. Tighten stabilizer link to frame tab fastener (4) to 34-41 Nm (25-30 ft-lbs).

*NOTE*

*If installing the stabilizer link causes interference between the rear tire and fender mounting hardware or the lower left crankcase and frame rail, the stabilizer link can be shorten or lengthened a short distance while fastened to frame tab and crankcase. Rotate the adjusting nut and rod (no more than two turns) to provide clearance. It is recommended to never turn the adjusting nut and rod more than two turns in or out with the stabilizer link fastened to the crankcase and the frame tab.*

6. Tighten lock nuts on stabilizer link ball ends (1) to 34-41 Nm (25-30 ft-lbs).




1. **Ball ends**
2. **Lock nuts**
3. **Adjusting nut**
4. **Stabilizer link to frame tab fastener @ 34-41 Nm (25-30 ft-lbs)**
5. **Frame tab**

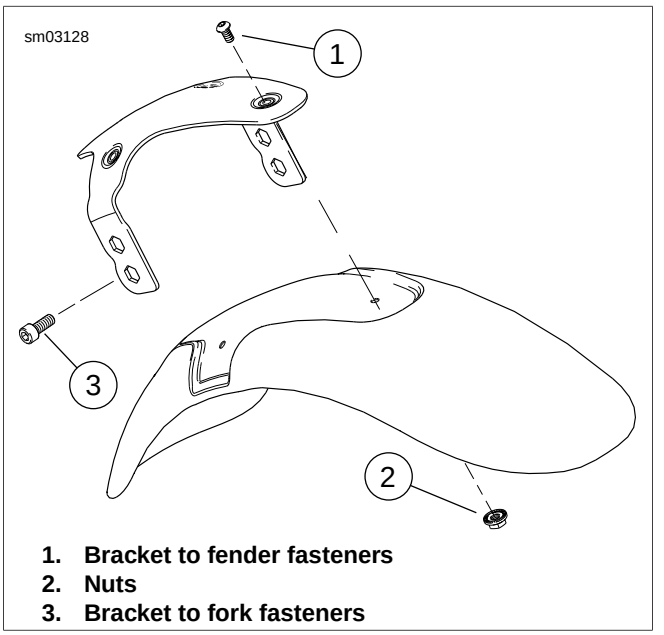
**Figure 2-99. Engine Stabilizer Link**

## REMOVAL

*NOTE*

*Be careful lifting fenders out of forks or you may scratch the paint. If necessary, cover fender with a clean shop rag to prevent damage.*

1. See Figure 2-100. Remove fasteners (3) from front fork and remove fender and bracket.




1. **Bracket to fender fasteners**
2. **Nuts**
3. **Bracket to fork fasteners**

**Figure 2-100. Front Fender (typical)**

2. Remove fasteners (1, 2) that hold bracket to fender and separate bracket and fender.

## INSTALLATION

*NOTE*

*Apply LOCTITE 262 to threads of fender fasteners before installation.*

1. See Figure 2-100. Attach fender to fender bracket. Tighten fasteners (1, 2) to 4.1-6.8 Nm (36-60 **in-lbs**).
2. Position fender and bracket in front fork and secure with fasteners (3). Tighten to 20-26 Nm (15-19 ft-lbs).

## REMOVAL

1. Support motorcycle so front end is off floor and forks are fully extended.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
4. Remove negative battery cable.
5. Remove both front brake calipers. See 2.17 FRONT BRAKE CALIPER.
6. Remove front wheel. See 2.24 FRONT WHEEL.
7. Remove front fender bracket with the front fender. See 2.32 FRONT FENDER.
8. See Figure 2-104. On one side, first loosen pinch bolt (5) on top triple clamp (4).
9. Break loose but do not remove fork tube cap (17).
10. Loosen pinch bolts (5) on bottom triple clamp (14) and pull fork tube and slider assembly (10) from triple clamp.
11. Repeat procedure for opposite fork tube and slider assembly (10).

## DISASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-41177 | FORK TUBE HOLDER |

1. See Figure 2-101. Clamp fork tube and slider assembly in FORK TUBE HOLDER (Part No. HD-41177) and mount in vise.
2. See Figure 2-104. While internal components are still under tension and less prone to rotate, break loose but do not completely unthread seat pipe screw (35). On right fork tube and slider assembly, remove axle holder (36) to access seat pipe screw.

**⚠WARNING**

**Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)**

3. Remove fork tube cap (17) and o-ring (18).
4. Remove the long spring collar (21).
5. Remove from FORK TUBE HOLDER and invert fork over a suitable container. Allow fork to drain. Extend and retract slider several times to push oil out of internal components. The washer (22), and spring (23) will fall out of fork tube.

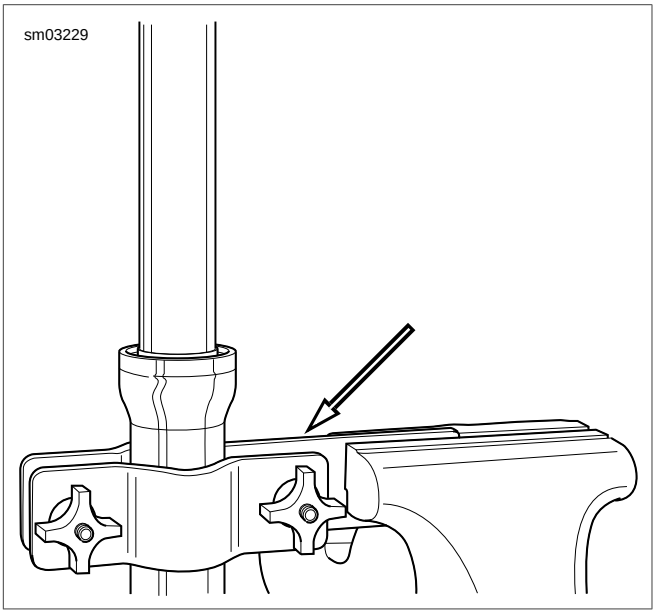



**Figure 2-101. Fork Holding Tool (mounted vertically to slider)**

6. Clamp fork tube in holder. Mount FORK TUBE HOLDER (HD-41177) horizontally in vise.
7. Remove slider cover (27) from slider by inserting brass drift into notch in slider and lightly tapping cover.
8. Compress stopper ring (29) and remove stopper ring from groove in top of slider bore.

*NOTE*

*The VRSC models have a preloaded fork spring. The seat pipe is under spring pressure. Always wear proper eye protection when disassembling the fork tube and slider assembly. Disassemble the fork tube and slider assemblies carefully. The springs can force parts from the fork tube or slider unexpectedly, which could result in death or serious injury.*

9. Remove seat pipe screw (35) and washer (34) from bottom of slider (33). Retain the seat pipe screw and washer.
10. Withdraw slider (33) from fork tube (19) until bushing guide (32) contacts bushing (20) on fork tube. Busing guide (32) is a slight interference fit in slider.
11. Using the slider as a slide hammer, hit the bushing with the bushing guide with a quick continuous stroke until slider is pulled free of the fork tube.
12. Drain the slider and allow the stop oil lock piece (26) to fall free.

*NOTE*

*If replacing the slider only, the components remaining in the fork tube can be left assembled and the fork re-assembled from ASSEMBLY procedures step 5.*

13. If still attached to seat pipe, remove stop oil lock piece (26) from the lower end of seat pipe.
14. Remove seat pipe (24) piston and ring assembly.

15. Remove rebound spring (23).
16. Remove oil seal (30), seal spacer (31), and bushing guide (32).
17. Repeat procedure for opposite fork tube and slider assembly (10).

## CLEANING AND INSPECTION

1. Thoroughly clean and inspect each part. If inspection shows that any parts are bent, broken or damaged, those parts should be repaired or replaced.
2. Inspect fork tube bushing and slider guide bushing and replace as required.
3. Always replace oil seals and o-rings.
4. Check dust cover where it rubs on fork tube. The dust cover should present a good continuous seal and not show excessive wear.
5. Check the fork tube where it rubs on dust cover. The tube should show a bright, shining surface, free of scoring or abrasions.
6. If springs are broken, replace springs.
7. If a fork tube or slider is bent or damaged, replace it.
8. Replace all other worn or damaged components as necessary.

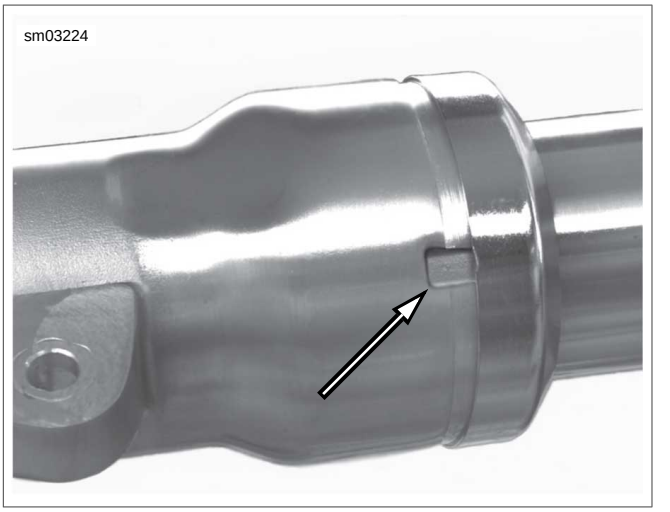
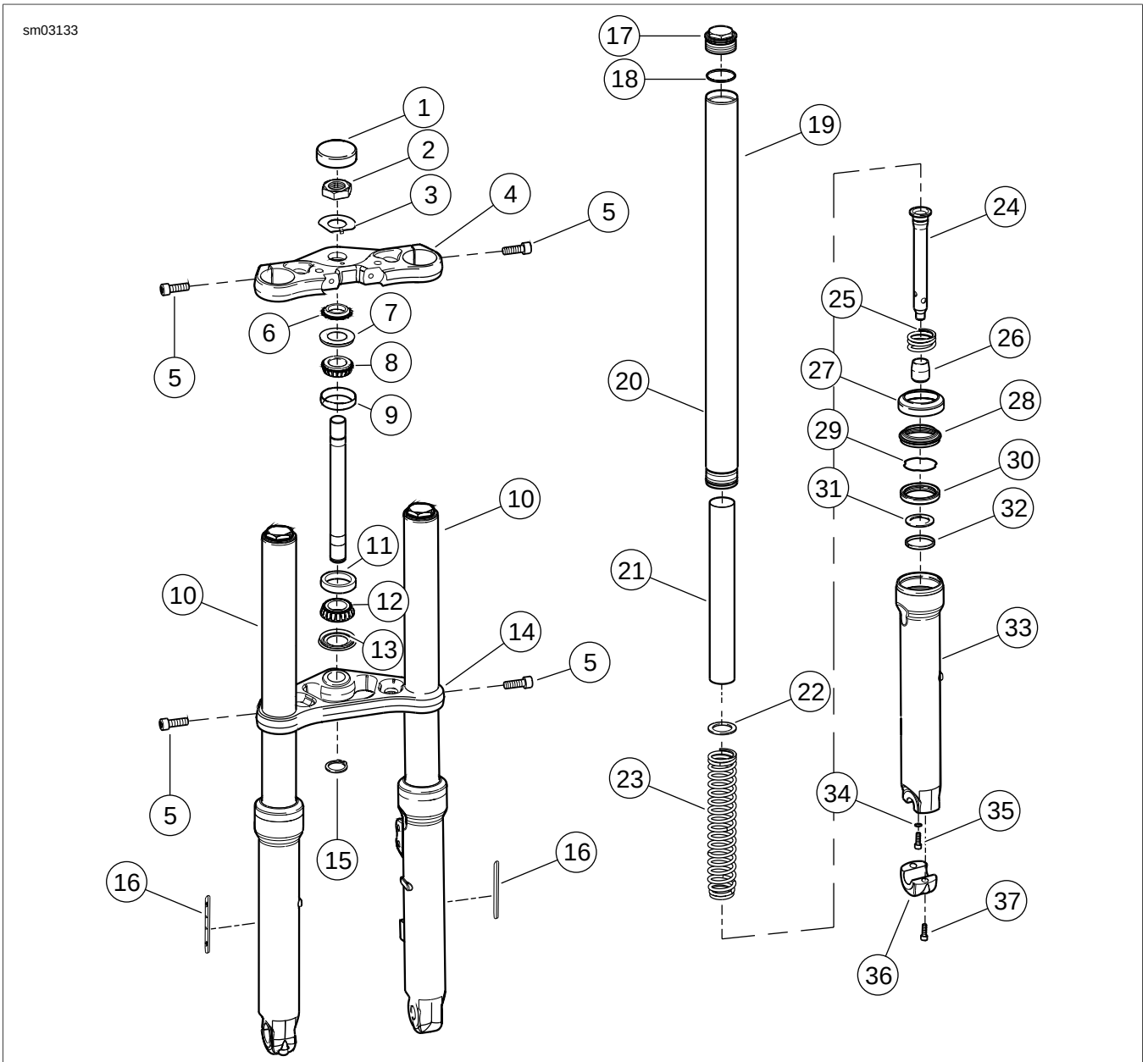



**Figure 2-102. Notch in Slider**




**Figure 2-103. Seat Pipe Screw (right fork assembly)**




1. Cap - fork stem
2. Nut - fork stem
3. Washer - fork stem nut
4. Top triple clamp
5. Pinch bolts
6. Adjusting nut - upper
7. Seal
8. Roller bearing
9. Bearing cup
10. Fork tube and slider assembly (right & left)
11. Bearing cup
12. Tapered roller bearing
13. Seal
14. Bottom triple clamp
15. Retaining ring
16. Reflector
17. Fork tube cap
18. O-ring
19. Fork tube (right & left)
20. Bushing
21. Spring collar
22. Washer
23. Rebound spring
24. Seat pipe
25. Spring
26. Stop oil lock piece
27. Slider cover
28. Dust shield
29. Stopper ring
30. Oil seal
31. Seal spacer
32. Bushing guide
33. Slider
34. Washer
35. Seat pipe screw
36. Axle holder
37. Axle holder screw

**Figure 2-104. Front Fork/Steering Head Components**

## ASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| B-45305 | FORK SEAL DRIVER |
| HD-41177 | FORK TUBE HOLDER |
| HD-59000A | PRO-LEVEL OIL GAUGE |
| HD-99884-80 | TYPE E FORK OIL |

1. See Figure 2-104. Insert seat pipe and piston assembly (24) with the rebound spring (23) into fork tube (19).
2. Slide bushing guide (32) down to bushing (20) on fork tube (19). Follow with spacer (31), oil seal (30), stopper ring (29), dust shield (28) and slider cover (27).
3. Install fork tube into FORK TUBE HOLDER (Part No. HD-41177) mounted horizontally in a vise.
4. Fit stop oil lock piece (26) onto seat pipe (24).
5. See Figure 2-105. Side seat pipe back into fork tube until seat pipe is centered in tube.
6. See Figure 2-104. Gently install slider (33) onto fork tube (19) and bushing (20).
7. Thread seat pipe screw (35) and washer (34) into seat pipe (24) through bottom of slider (33). Draw fastener into seat pipe but do not torque.
8. Verify action of fork by sliding slider up and down fork tube.
9. Assemble the FORK SEAL DRIVER (Part No. B-45305) over fork tube in front of oil seal.

*NOTE*

*Chamfered lips on oil seal MUST face towards oil in fork.*

10. See Figure 2-106. Holding Fork Seal Driver (4) together assemble in the following order. Tap oil seal (3), spacer (2) and bushing guide (1) into slider bore.

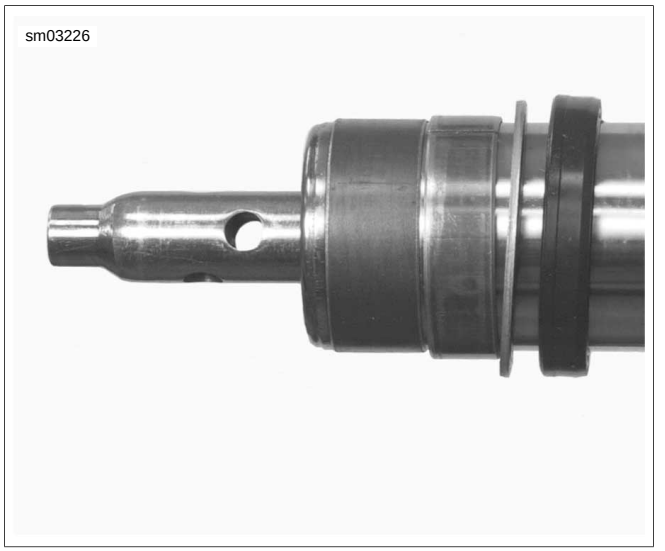
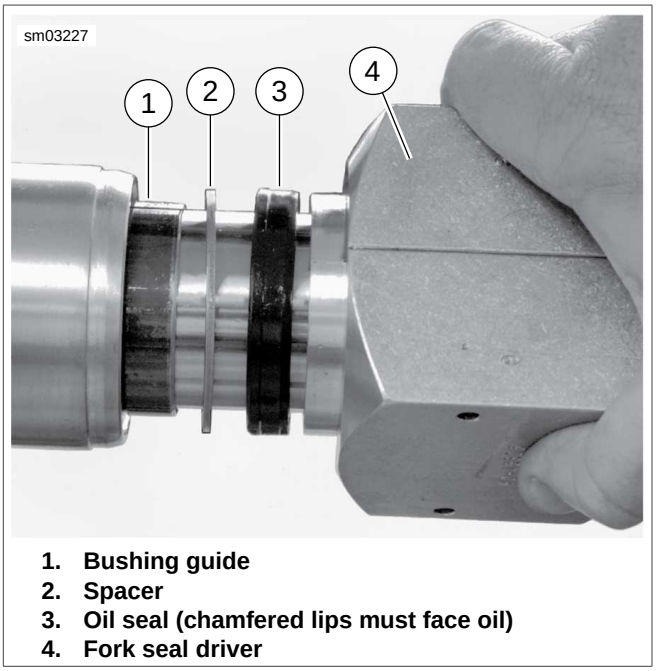



**Figure 2-105. Seat Pipe Centered in Fork Tube**




1. **Bushing guide**
2. **Spacer**
3. **Oil seal (chamfered lips must face oil)**
4. **Fork seal driver**

**Figure 2-106. Assembled Fork Seal Driver**

11. See Figure 2-104. Install stopper ring (29) into groove in top of oil seal.
12. Push dust shield (28) against oil seal and stopper ring
13. Rotate slider cover to match any removal burrs to notch in slider and snap slider cover (27) into place.
14. Move slider through its full range of travel several times to verify alignment. Then, pulling down on slide to apply downward force on rebound spring (23), tighten seat pipe screw to 12-18 Nm (106-159 **in-lbs**) .
15. Re-position fork tube in FORK TUBE HOLDER (Part No. HD-41177) vertically. With slider tube compressed, fill the fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) until it is approximately 91 mm (3.6 in.) from top of fork tube.
16. Slowly pump slider 8 to 10 times to exhaust air from assembly. Fully compress slider to determine oil level.

*NOTE*

*Fork oil level is measured from top of fork tube, with spacer and spring removed and fork fully compressed.*

17. Using the PRO-LEVEL OIL GAUGE (Part No. HD-59000A), adjust the oil level to 91 mm (3.6 in.) from top of fork tube.
18. Pull out the slider (33) and install the rebound spring (23) in the fork tube with the tightly wound end at the bottom.
19. Install the washer (22) and spring collar (21).

**⚠WARNING**

**Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)**

20. With a **new** o-ring, install and tighten fork tube caps to 22-58 Nm (16-43 ft-lbs).

*NOTE*

*To prevent cross threading fork tube caps, use caution when threading in the caps with the spring compressed.*

21. Repeat for opposite fork tube and slider assembly.

## INSTALLATION

1. See Figure 2-107. Insert fork tube and slider assemblies through lower triple clamp and upper triple clamp. fork tubes should project above upper triple clamp, 6.4-9.7 mm (0.25-0.38 in.). Tighten pinch bolts to 41-47 Nm (31-34 ft-lbs).
2. Install front fender and bracket. See 2.32 FRONT FENDER.
3. Install front brake caliper hydraulic lines and install front brake calipers. See 2.17 FRONT BRAKE CALIPER.
4. Install front wheel and align the wheel to the forks. See 2.24 FRONT WHEEL.
5. Adjust fall-away. See 1.21 STEERING HEAD BEARINGS.
6. Replace negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
7. Replace airbox cover
8. Replace maxi-fuse and right side cover.

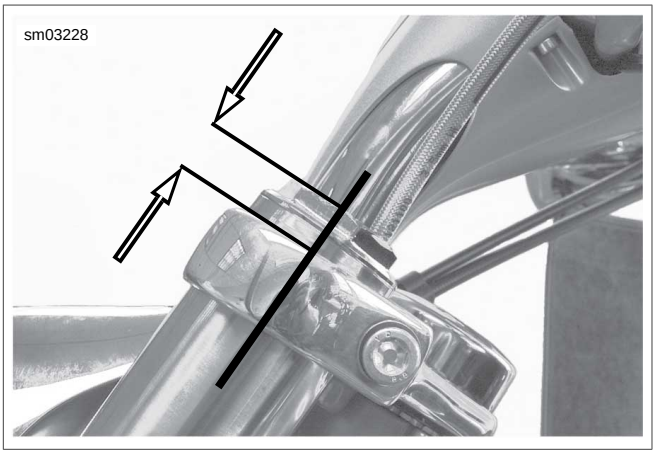


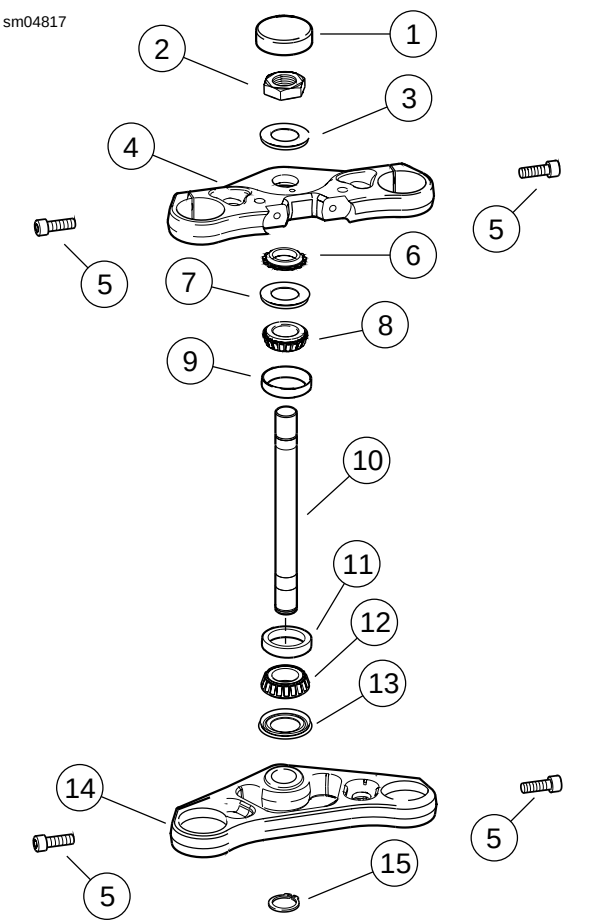

**Figure 2-107. Fork Tube Protrusion: Typical**

## REMOVAL

*NOTE*

*If bearing races are removed, the bearings cannot be reused-they must be replaced. See 2.34 STEERING HEAD, Cleaning and Inspection.*

1. Support motorcycle so front end is off floor and forks are fully extended.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Remove headlamp and headlamp bracket. See 8.7 HEADLAMP: VRSCAW, or 8.8 HEADLAMP: VRSCD/VRSCDX.
4. Remove both front brake calipers. See 2.17 FRONT BRAKE CALIPER.
5. Remove front wheel. See 2.24 FRONT WHEEL.
6. Remove front fender bracket with front fender. See 2.32 FRONT FENDER.
7. Loosen but do not remove fork tube caps.
8. See Figure 2-108. Loosen all pinch bolts on top and bottom triple clamps and pull fork tubes from triple clamps. See 2.33 FRONT FORK.
9. Remove brake hose bracket from the bottom of fork stem (10) and bracket.
10. Remove fork stem cap (1) and remove fork stem nut.
11. Lift handlebars from steering head with upper triple clamp (4) attached. Be careful not to pinch or kink control cables.
12. Remove adjusting nut (6), seal (7), and upper bearing (8) out of bearing race.
13. Pull fork stem (10) and lower triple clamp (14) from bottom of steering head.




1. **Cap**
2. **Nut**
3. **Washer**
4. **Upper triple clamp**
5. **Pinch bolt**
6. **Adjusting nut**
7. **Seal**
8. **Upper bearing**
9. **Bearing cup**
10. **Fork stem**
11. **Bearing cup**
12. **Lower bearing**
13. **Seal**
14. **Lower triple clamp**
15. **Retaining ring**

**Figure 2-108. Steering Head (typical)**

## CLEANING AND INSPECTION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-33416 | UNIVERSAL DRIVER HANDLE |
| HD-39301-A | STEERING HEAD BEARING RACE REMOVER |
| HD-95637-46A | UNIVERSAL WEDGE ATTACHMENT |

1. Check upper and lower bearing races in steering head. If they are pitted or grooved, replace bearings and races in sets.
2. Check roughness of bearings by turning them in race. Replace bearings if they do not turn freely and smoothly.

**CAUTION**

**Replace both bearing assemblies even if one assembly appeares to be good. Mismatched bearings can lead to excessive wear and premature replacement. (00532b)**

### Lower Fork Stem Bearing

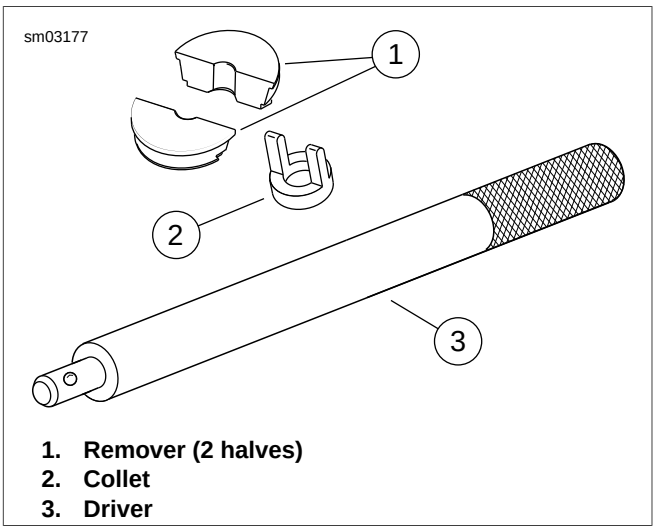
1. See Figure 2-109. Assemble a bearing puller using a using a UNIVERSAL WEDGE ATTACHMENT (Part No. HD-95637-46A) , two lengths of threaded rod, washers, nuts, a cross clamp or bridge, and a forcing screw and a washer or protective cap.
2. Turn forcing screw to remove bearings and seal from lower triple clamp.

### Steering Head Bearing Race

1. See Figure 2-110. With the tapered side down, seat STEERING HEAD BEARING RACE REMOVER (Part No. HD-39301-A) on upper bearing race leaving a gap in middle and with lower lip of removers capturing bottom edge of bearing race.
2. Install collet on driver.
3. Insert UNIVERSAL DRIVER HANDLE (Part No. HD-33416) at bottom of steering head tube, and while holding remover tool on race, center collet in gap between remover halves. Tap driver to remove upper race.
4. Reverse tool and repeat procedure to remove lower bearing race.




**Figure 2-109. Bearing Puller Based on Universal Wedge Attachment (typical)**




1. **Remover (2 halves)**
2. **Collet**
3. **Driver**

**Figure 2-110. Race Remover Tools (HD-33416 and HD-39301-A)**

## ASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-39302 | STEERING HEAD BEARING RACE INSTALLER |

1. Lubricate outside of **new** steering head bearing races with lubricant provided or engine oil.
2. See Figure 2-111. Assemble STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302) and bearing races on tool's draw down bolt through steering head. Orient races so lettered edges are at bottom of steering head bore in steering head.
3. Continue to thread nut on draw down bolt until races fit, and are parallel to steering head bore.
4. Slowly tighten nut while stopping periodically to check for bearing race to steering head parallelism.

**⚠WARNING**

**Properly seat bearing cups in steering head bore. Improper seating can loosen fork stem bearings adversely affecting stability and handling, which could result in death or serious injury. (00302a)**

5. When bearing races are fully seated in bore of steering head, pack **new** bearings with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE (HD-99857-97).

*NOTE*

*Do not use a sleeve that is larger than the inner race of the bearing or bearing cage may be damaged. A damaged bearing cage will require replacement of both the cage and the bearing.*

6. Install a **new** lower seal on fork stem.
7. Use sleeve or drift that will contact only inner race of bearing and press lower bearing into place on fork stem.

*NOTE*

*A sleeve (drift) to press on the lower fork stem bearing can be constructed out of thick walled pipe, 22.86 cm (9.0 in.) long with an inside diameter of 25.65 mm (1.010 in.) and an outside diameter of 31.75 mm (1.250 in.).*

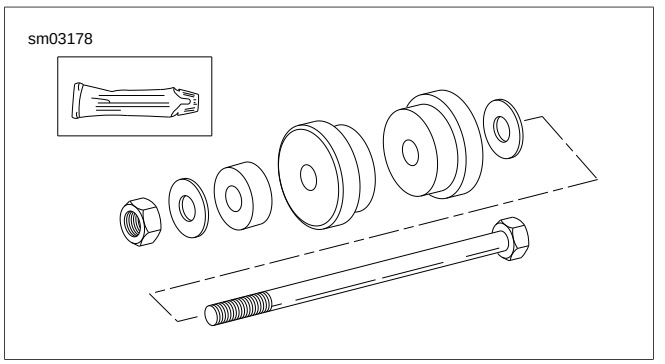



**Figure 2-111. Steering Head Bearing Race Installer (HD-39302)**

## INSTALLATION

1. See Figure 2-107. Insert fork stem (10) and lower triple clamp (14) assembly into frame steering head and install a **new** upper bearing (8) and **new** seal (7). Secure with adjusting nut (6). Tighten adjusting nut until bearings have no noticeable shake. Fork stem must turn freely from side to side.

**⚠WARNING**

**Properly adjust fork stem bearings. Improper adjustments affect stability and handling, which could result in death or serious injury. (00301a)**

2. Install upper triple clamp (4), and washer (3).

**⚠WARNING**

**Properly adjust fork stem bearings. Improper adjustments affect stability and handling, which could result in death or serious injury. (00301a)**

3. Thread on and finger tighten fork stem nut (2).
4. Fasten brake hose bracket to lower triple clamp (14). Tighten bolt to 53-89 **in-lbs** (6-10 Nm).
5. Install fork tube assemblies into bottom and top triple clamps (4, 14).
6. See Figure 2-107. The fork tube should be recessed in triple clamp approximately 1.7 mm (0.070 in.). Tighten pinch bolts to per appropriate fork rebuild procedure.
7. Install handlebar brackets, handlebars, clutch and brake lever assemblies.
8. Install front fender and bracket. See 2.32 FRONT FENDER.
9. Install front wheel assembly. See 2.24 FRONT WHEEL.
10. Install right and left front brake calipers. See 2.17 FRONT BRAKE CALIPER.
11. See Figure 2-107. Adjust steering head bearing fall away. Tighten or loosen adjusting nut (6) until the fall away measurement is within 51-102 mm (2-4 in.). See 2.34 STEERING HEAD.
12. Tighten fork stem nut (2) to 95-108 Nm (70-80 ft-lbs).
13. Replace fork stem cap (1).

## GENERAL

To ensure that the ignition key and the fork lock key are the same, both locks may need to be changed when one is changed.

## REMOVAL

1. Remove the upper triple clamp.
2. See Figure 2-112. Insert ignition key (1) and turn 1/2 way so that plunger (4) rotates in plunger boss (9).
3. Look into the half-moon opening (8) on back of fork lock boss. The slot (5) in plunger (4) should be visible in the opening.

*NOTE*

*If the plunger shot is not visible in the half-moon opening with the key 1/2 way between lock and unlock, the plunger can be rotated with pliers counterclockwise to compress the rotation pin and remove the plunger.*

4. Using a thin tool, press in rotation pin (3) through slot (5) in plunger.
5. While pressing rotation pin (3) in, push up through small hole in bottom of plunger boss (9) until plunger (4) holds rotation pin (3) in. Remove tool and continue to push plunger (4) out of plunger boss (9).
6. Use ignition key (1) to pull tumbler (7) out.

## INSTALLATION

1. Lightly grease open end of tumbler.

*NOTE*

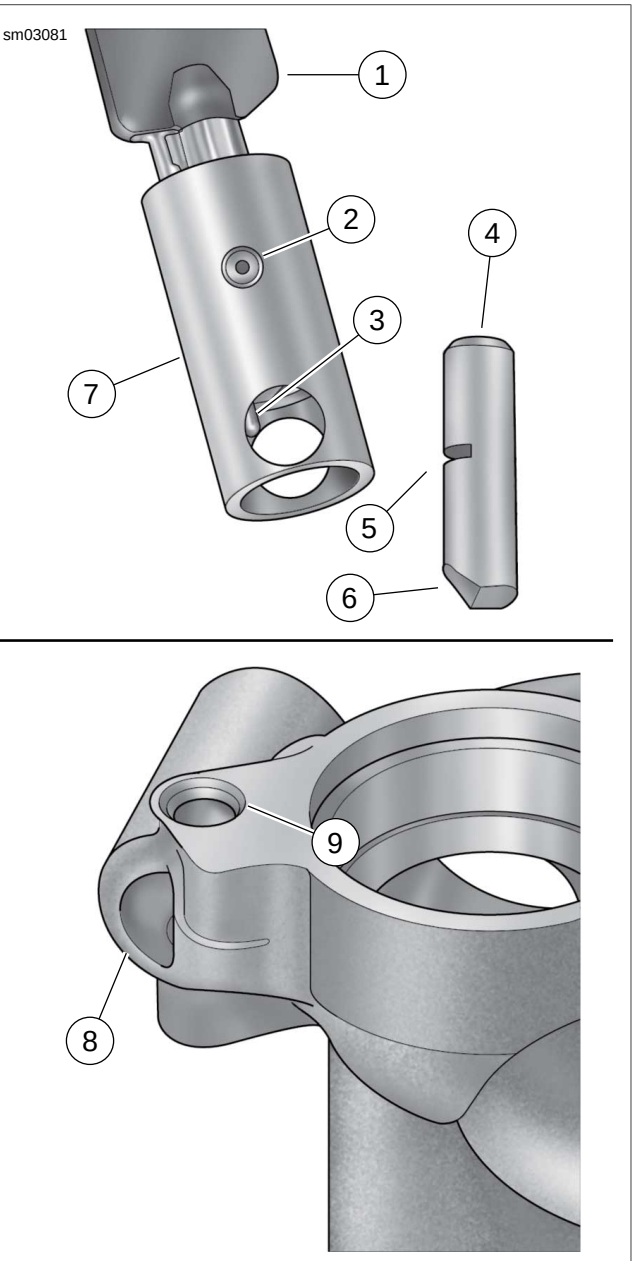
*The lock can be installed so that the key will lock the forks with either a counterclockwise or clockwise turn. When the splined retaining key is on top of tumbler, the key will rotate counter-clockwise to lock the forks and clockwise to unlock the forks.*

2. See Figure 2-112. Slide tumbler (7) into fork lock boss (8) with rotation pin (3) and retaining key (2) at the top of the fork lock boss (8).

*NOTE*

*The beveled end of the plunger will compress the rotation pin so that the plunger can be slid into place.*

3. With the beveled end of plunger (6) facing the rotation pin (3), push the plunger into boss until plunger locks into place.
4. Turn the key from notch to notch. Locking pin should be below fork lock boss in unlocked position and 6.35 mm (1/4 in) above boss in locked position.
5. Install upper triple clamp.




1. **Key - 1/2 way rotation**
2. **Retaining key**
3. **Rotation pin - 1/2 way rotation**
4. **Plunger**
5. **Plunger slot**
6. **Plunger bevel**
7. **Tumbler**
8. **Half-moon opening - fork lock boss**
9. **Plunger boss**

**Figure 2-112. Fork Lock Components**

## REMOVAL

### Belt Guard

1. See Figure 2-113. Unthread left side lower shock mount bolt from belt guard (1) without removing shock mount bolt from swingarm.
2. Pull belt guard (1) rearward off of side rubber grommet (5) and upper rubber grommet (6). If necessary, remove fasteners (3) holding grommets (5, 6) to swingarm.
3. Inspect rubber grommets (5, 6) on the swingarm and remove the bolts and rubber grommets if necessary.

### Debris Deflector

1. See Figure 2-113. Remove fastener (3) and washer (4) from the underside of the swingarm near the rear shock mount.
2. Pull the debris deflector (8) rearward off of the lower rubber grommet (7) and remove the debris guard.
3. Inspect the rubber grommet (7) on the swingarm and remove the bolt and rubber grommet if necessary.

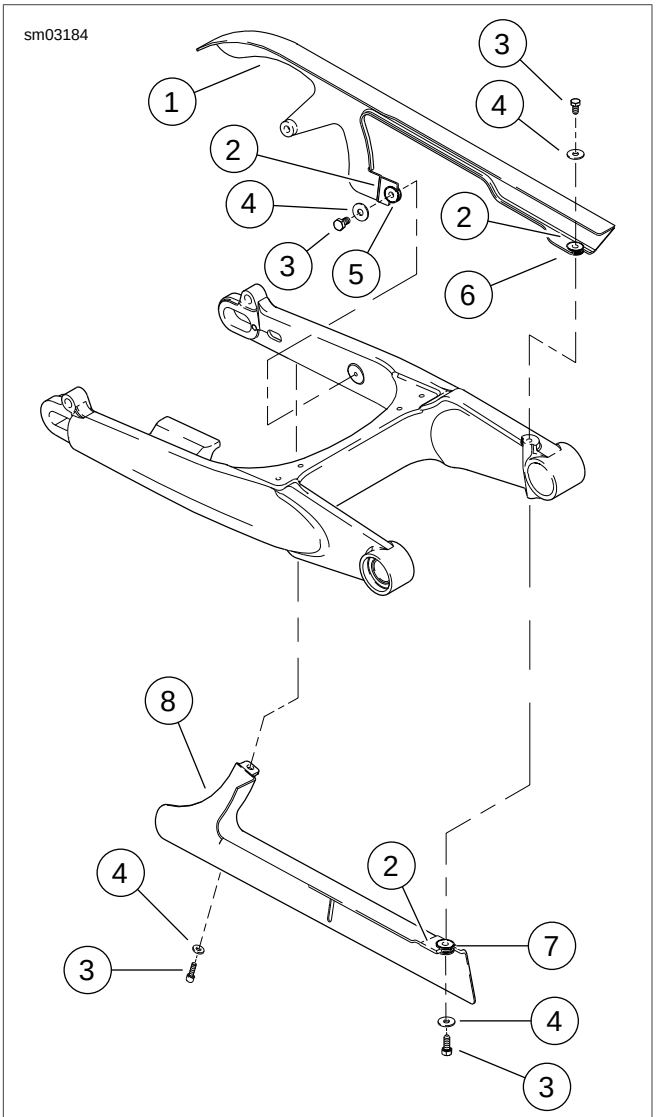
## INSTALLATION

### Belt Guard

1. See Figure 2-113. If necessary, replace the rubber grommets (5, 6) and bolts. Tighten bolts to 6-10 Nm (53-88 **in-lbs**).
2. Slide the belt guard slots into position on the rubber grommets.
3. Thread lower rear shock mount into thread boss on belt guard. See 2.37 REAR SHOCK ABSORBERS.
4. Measure guard to drive sprocket clearance.
5. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.

### Debris Deflector

1. See Figure 2-113. If necessary, replace rubber grommet (7) and fastener (3). Tighten fastener to 6-10 Nm (53-88 **in-lbs**).
2. Slide debris deflector slot (2) into position on the rubber grommet (7).
3. Thread rear fastener (3) and washer (4) through debris deflector (8) into Swingarm. Tighten fastener to 6-10 Nm (53-88 **in-lbs**).




1. **Belt guard**
2. **Slot**
3. **Fastener**
4. **Washer**
5. **Side rubber grommet**
6. **Upper rubber grommet**
7. **Lower rubber grommet**
8. **Debris deflector**

**Figure 2-113. Belt Guard/Debris Deflector (typical)**

## REMOVAL

1. Using a suitable lift, support motorcycle under frame until rear tire is slightly off the ground.
2. See Figure 2-114. Remove right side lower fastener (1), washer (5), and thin height hex-nut (6) attaching right side shock to Swingarm.
3. Remove left lower fastener (1) and washer (5) from left side shock to Swingarm and belt guard. Allow rear tire to rest on ground.
4. Remove left side upper fastener (3) from left side top shock mount and remove shock.
5. Remove right side fastener (2) from right side top shock mount and remove shock.

*NOTE*

*The rear shock absorbers on VRSC motorcycles are not repairable. If a shock absorber becomes worn or damaged, it must be replaced as an assembly.*

## INSTALLATION

1. See Figure 2-115. Insert right side upper fastener (2) into right side top shock mount.
2. Insert left side upper fastener (3) into left side top shock mount.
3. Pivot shock absorbers to align lower shock mounts with mounting holes in swingarm.
4. Lift swingarm to meet lower shock mounts.
5. Thread left side lower fastener (1) and washer (5) through shock mount and swingarm into belt guard.
6. Thread right side lower fastener (1) and washer (5) through bottom shock mount in swingarm into thin height nut.
7. Tighten upper and lower shock mount fasteners to 41-68 Nm (31-50 ft-lbs) .

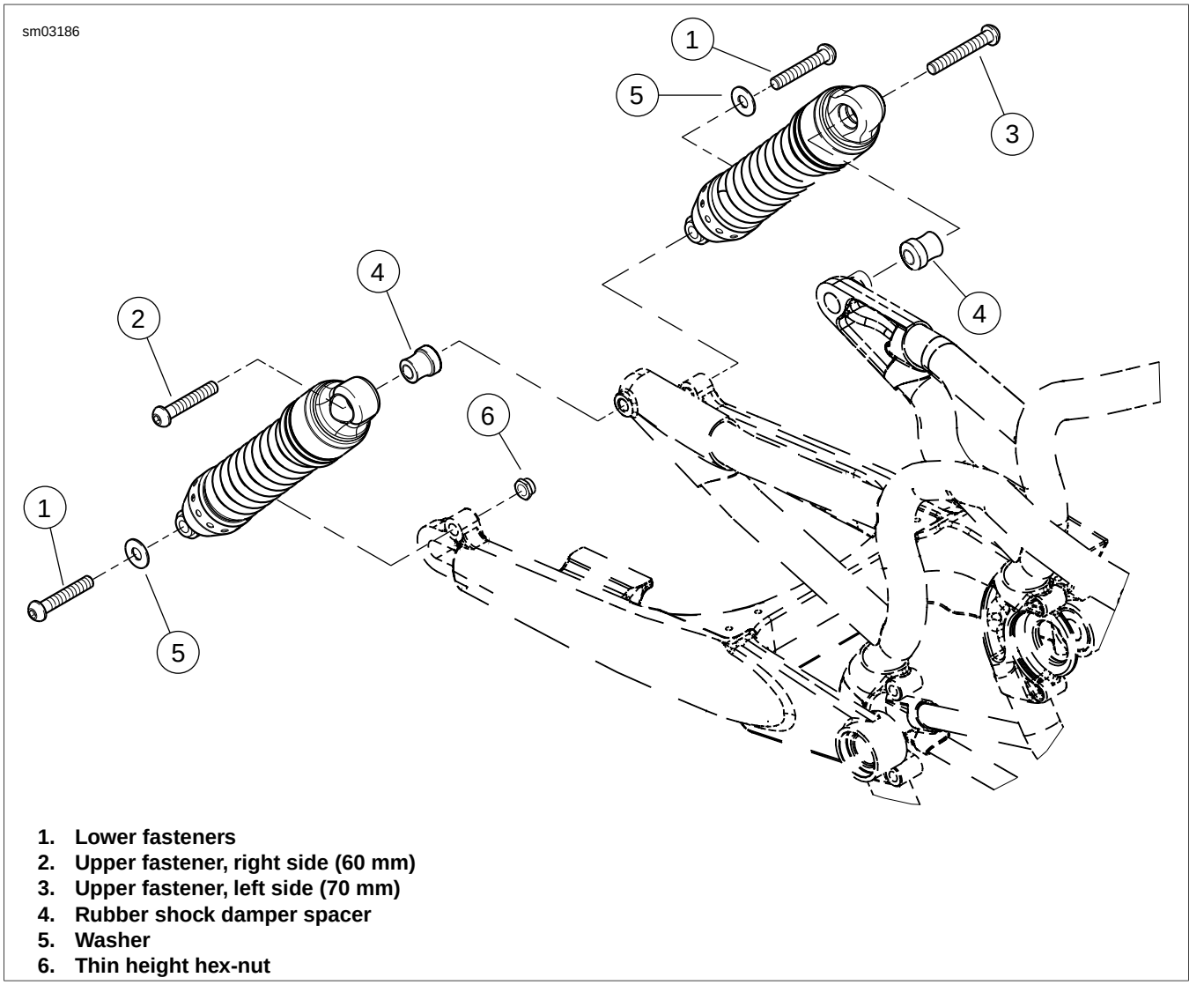
**⚠WARNING**

**Be sure both shock absorbers are adjusted to same preload position. Improper adjustment can adversely affect stability and handling, which could result in death or serious injury. (00036a)**

8. Verify that preload settings on both shock absorbers are equal. See 1.20 SUSPENSION ADJUSTMENTS.

*NOTE*

*See 1.20 SUSPENSION ADJUSTMENTS for information regarding setting up the suspension for carrying cargo.*




1. **Lower fasteners**
2. **Upper fastener, right side (60 mm)**
3. **Upper fastener, left side (70 mm)**
4. **Rubber shock damper spacer**
5. **Washer**
6. **Thin height hex-nut**

**Figure 2-114. Rear Shock Absorbers**

## REMOVAL

*NOTE*

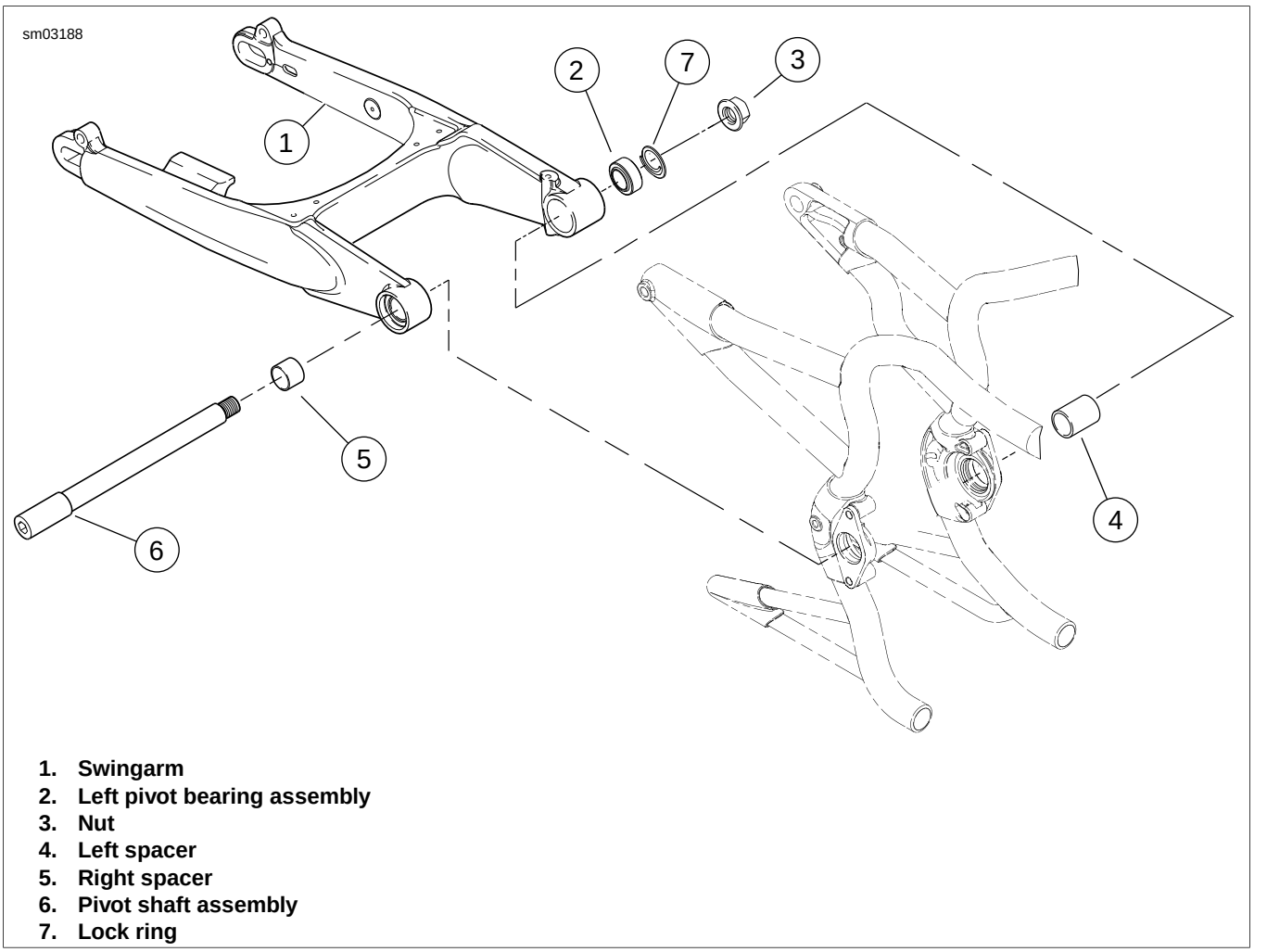
*Mark all hardware as it is removed so that it may be returned to its original location.*

1. Remove right side cover and maxi-fuse.
2. Remove belt guard and debris deflector. See 2.36 BELT GUARD AND DEBRIS DEFLECTOR.
3. Remove rear wheel. See 2.27 REAR WHEEL.
4. Remove rear brake caliper brake fluid line from clips on rear swingarm. See 2.21 REAR BRAKE CALIPER.
5. Remove left lower rear shock absorber bolt. Remove right rear shock absorber bolt and thin height nut. See 2.37 REAR SHOCK ABSORBERS.

*NOTE*

*Block or support engine before removing pivot shaft. Pivot bearing (2) will stay with swingarm when swingarm is removed from motorcycle.*

6. See Figure 2-115. Remove pivot shaft nut (3).
7. Support rear swingarm (1) and slide pivot shaft (6) out. Rear swingarm can now be removed from frame.




1. **Swingarm**
2. **Left pivot bearing assembly**
3. **Nut**
4. **Left spacer**
5. **Right spacer**
6. **Pivot shaft assembly**
7. **Lock ring**

**Figure 2-115. Rear Swingarm (typical)**

## DISASSEMBLY AND ASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-44060-4 | WHEEL BEARING REMOVAL/REPLACEMENT KIT |
| HD-47175 | SWINGARM BEARING INSTALLATION TOOL |
| HD-47175 | SWINGARM BEARING INSTALLATION TOOL |

*NOTES*

- *Remove left pivot bearing assembly from fork only if replacement is required. the complete bearing assembly must be replaced as a unit when replacement is necessary. Do not intermix bearing components.*
- *The rear fork has been designed to incorporate a lock ring that MUST be removed before attempting to remove the left-side bearing. Using a small screwdriver or pick, catch the end of lock ring and remove ring from swingarm in a spiral fashion as shown in the following figures.*




**Figure 2-116. Remove Nut and Axle**



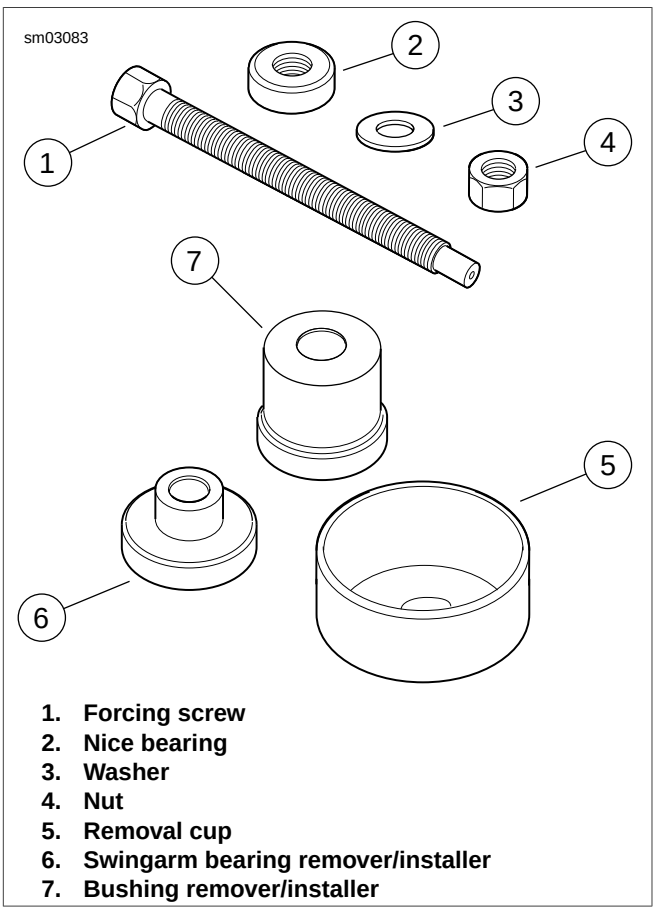

**Figure 2-117. Locate End of Lock Ring**




**Figure 2-118. Slowly spiral ring out of groove**

## General

The SWINGARM BEARING INSTALLATION TOOL (Part No. HD-47175) is used with parts from WHEEL BEARING REMOVAL/REPLACEMENT KIT (Part No. HD-44060-4) as shown in Figure 2-119. Parts used are forcing screw (1), bearing (2), washer (3) and nut (4) to replace the swingarm bearings on all 2005 and later VRSC model motorcycles.




1. **Forcing screw**
2. **Nice bearing**
3. **Washer**
4. **Nut**
5. **Removal cup**
6. **Swingarm bearing remover/installer**
7. **Bushing remover/installer**

**Figure 2-119. Parts Used From HD-44060-4 Kit (1-4) and Swingarm Bearing Installation Tool**

*NOTE*

*Always remove the bearing/bushing from the inside of swingarm going outward (see arrows). When installing rear bearings/bushings, install from the outside going inward (see arrows).*

1. Remove rear swingarm. See 2.38 SWINGARM, Removal.

*NOTE*

*When mounting swingarm in holding device, protect swingarm to avoid finish damage.*

2. Place swingarm assembly on a suitable work surface in suitable holding device.

## Left Side Swingarm Bearing Removal

1. See Figure 2-120. Position Remover Cup against inner left arm of swingarm with cupped side facing swingarm
2. Install forcing screw through small hole in Remover Cup.
3. Install SWINGARM BEARING INSTALLATION TOOL (Part No. HD-47175), bearing, washer and nut.
4. Tighten forcing screw until bearing pulls free from swingarm housing.
5. Once bearing has been removed from swingarm, disassemble tool and remove components from swingarm. Discard old swingarm bearing.




**Figure 2-120. Remove Left Side Swingarm Bearing (typical)**

## Left Side Swingarm Bearing Installation

*NOTE*

*Do not tighten tool past the point of seating the swingarm bearing or bearing damage can result.*

1. See Figure 2-121. Load **new** swingarm bearing onto swingarm bearing remover/installer and insert into swingarm.
2. Install forcing screw through small hole in Bearing Remover/Installer.
3. Position Remover Cup against inner left arm of swingarm with cupped side facing swingarm.
4. Install bearing and nut.
5. Tighten nut and forcing screw finger tight.

*NOTE*

*When installing bearing, hold the end of the tool without the bearing stationary, and tighten the end with bearing installed.*

6. Tighten tool until bearing seats in swingarm housing. DO NOT overtighten.
7. Loosen and remove tool.
8. Check swingarm bearing for free movement.

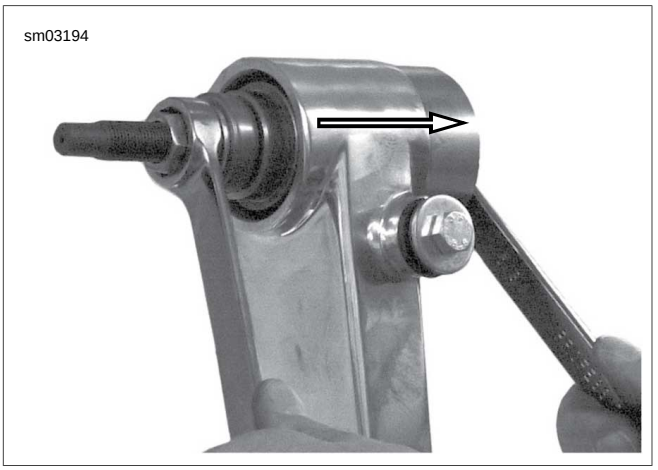



**Figure 2-121. Install Left Side Swingarm Bearing (typical)**

## Right Side Bushing Removal

1. See Figure 2-122. Position Removal Cup against outer right arm of swingarm with cupped side facing swingarm
2. Install forcing screw through small hole in remover cup.
3. Install Bushing Remover/Installer, bearing, washer and nut.
4. Tighten forcing screw until bushing pulls free from swingarm housing.
5. Once bushing has been removed from swingarm, disassemble tool and remove components from swingarm. Discard old bushing.

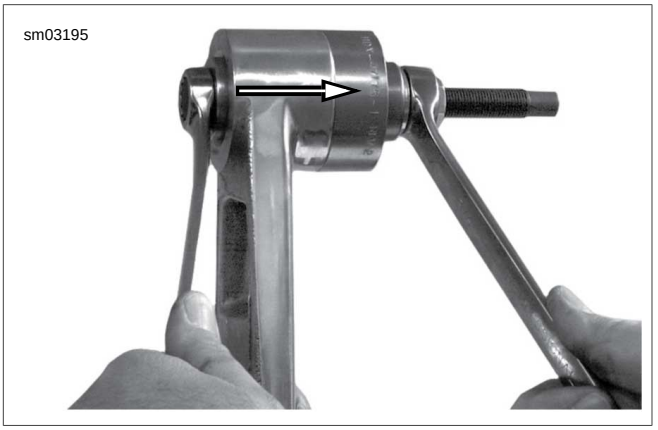



**Figure 2-122. Remove Right Side Bushing (typical)**

## Right Side Bearing Installation

1. See Figure 2-123. Load **new** bushing onto bushing remover/installer and insert into outer side of right swingarm.

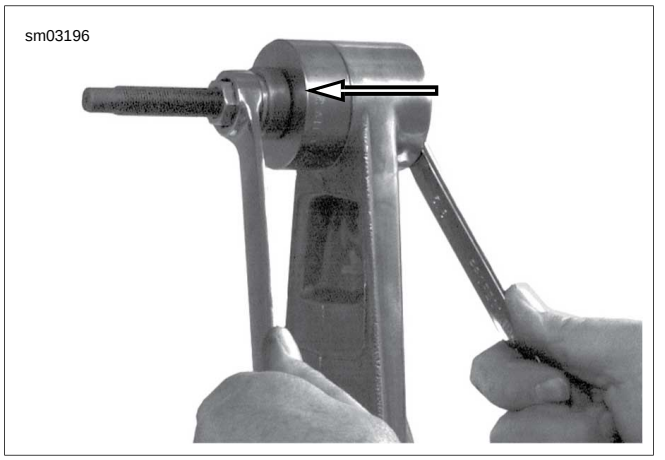



**Figure 2-123. Install Right Side Bushing (typical)**

2. Install forcing screw through small hole in Bushing Remover/Installer.
3. Position Remover Cup against outer left arm of swingarm with cupped side facing swingarm.
4. Install bearing and nut.
5. Tighten nut and forcing screw finger tight.

*NOTE*

*When installing bushing, hold the end of the tool without the bearing stationary, and tighten the end with bearing installed.*

6. Tighten tool until bushing is at desired position in swingarm housing.
7. Loosen and remove tool.

*NOTE*

*When installing bushing, tighten tool and begin installation process, stop and back tool off after a few turns and view how far the bushing has been pressed into the swing arm assembly. Bushing should be evenly centered between beveled edges of swingarm casting.*

8. Check position of bushing in swingarm housing.
9. See Figure 2-124. Slowly spiral lock ring into recess in swingarm using a clockwise turning motion.




**Figure 2-124. Insert Lock Ring**

10. See Figure 2-125. Verify that lock ring has completely seated in swingarm.




**Figure 2-125. Lock Ring Fully Seated**

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-47176 | SWINGARM GUIDE |

1. See Figure 2-126. Install SWINGARM GUIDE (Part No. HD-47176) into pivot shaft cavity in frame.

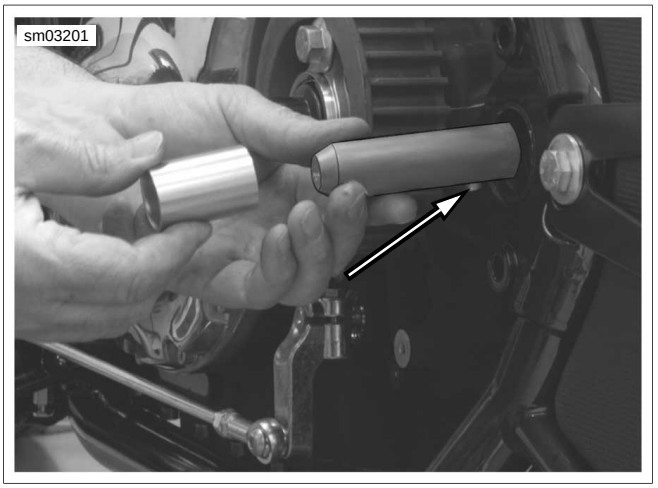



**Figure 2-126. Install Swingarm Guide**

2. See Figure 2-127. Slide left-side external swingarm spacer onto swingarm guide.

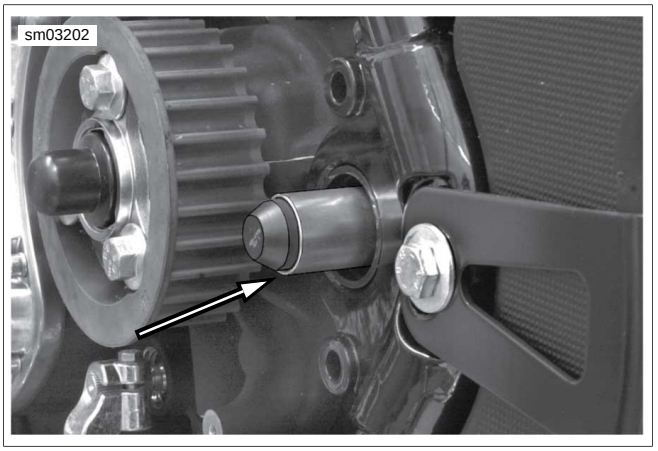



**Figure 2-127. Install Left Spacer**

3. See Figure 2-128. Push swingarm guide flush with face of left side spacer.




**Figure 2-128. Push Guide flush with Spacer**

*NOTE*

*When installing rear swingarm and inserting swingarm pivot shaft, swingarm assembly guide will stick to threaded end of pivot shaft via magnet.*

4. Install rear swingarm.
5. Slide swingarm assembly into position.
6. Apply a liberal coat of LOCTITE® ANTI-SEIZE LUBRICANT to pivot shaft.
7. See Figure 2-115. From right side, slide pivot shaft (6) through dust seals, rear fork pivot bearing, bushing and engine mounts, spacers.
8. Apply two or three drops of LOCTITE® 243 (blue) to threads of Install and tighten pivot shaft nut to 61-75 Nm (45-55 ft-lbs).

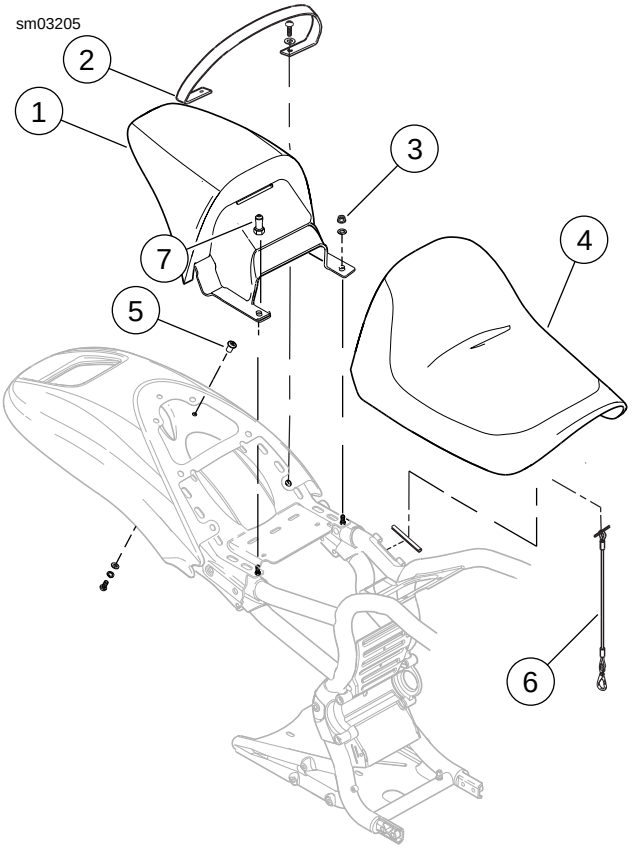
*NOTE*

*Proper pivot shaft tightening is important to maintain rear fork alignment.*

9. Check for freedom of rotation of swingarm around bearings and that fork and frame side rails have not been distorted when pivot shaft nut was tightened.
10. Install both rear shock absorbers. See 2.37 REAR SHOCK ABSORBERS.
11. Install rear brake caliper and clip brake line to swingarm.
12. Install rear wheel.
13. Install belt guard and debris deflector. See 2.36 BELT GUARD AND DEBRIS DEFLECTOR.
14. Install Maxi-Fuse and right side cover.

## REMOVAL

1. Open seat.
2. See Figure 2-130. Remove seat lanyard (6) from the hole in frame.
3. Pry hinge clip from seat hinge pins. Slide seat rearward to release hinge pins from bushings on frame.
4. Remove pillion mounting bolt and washer (5). Save bolt and washer for installation. Slide grabstrap (2) forward off pillion.
5. Push pillion forward to release slot on the bottom of pillion from tongue on fender. Lift pillion back and away from motorcycle.
6. If necessary, remove grabstrap.




1. **Pillion**
2. **Grabstrap**
3. **Mounting nut and washer**
4. **Rider's seat**
5. **Pillion mounting assembly**
6. **Lanyard**
7. **Seat retaining post**

**Figure 2-129. Seat and Pillion**

## CLEANING AND INSPECTION

1. Inspect all components for wear or damage.
2. Clean underside of pillion and seat. Clean fender and frame mounting surfaces.

*NOTE*

*Do not use ordinary soap to clean the seat. Thoroughly clean with a quality saddle soap. Once the seat is dry, it can be treated with Harley-Davidson Leather Care Dressing (Part No. 98261-91V).*




**Figure 2-130. Seat Hinge**

## INSTALLATION

1. If necessary, install grabstrap. Tighten to 11-17 Nm (97-150 **in-lbs**).
2. Push pillion toward front of motorcycle until mounting hole in base is approximately 25 mm (1 in.) in front of mounting hole in frame.
3. While applying downward pressure on middle of pillion, slide pillion rearward to fully engage slot on bottom with tongue on top of fender. Push rearward until mounting hole on pillion base is aligned with mounting hole in frame.
4. Install pillion base to frame. Tighten fastener to 11-17 Nm (97-150 **in-lbs**).
5. Install seat. Make sure both seat pins engage their bushings on the frame.
6. Press clip over seat hinge.
7. Install seat lanyard to hole in frame.

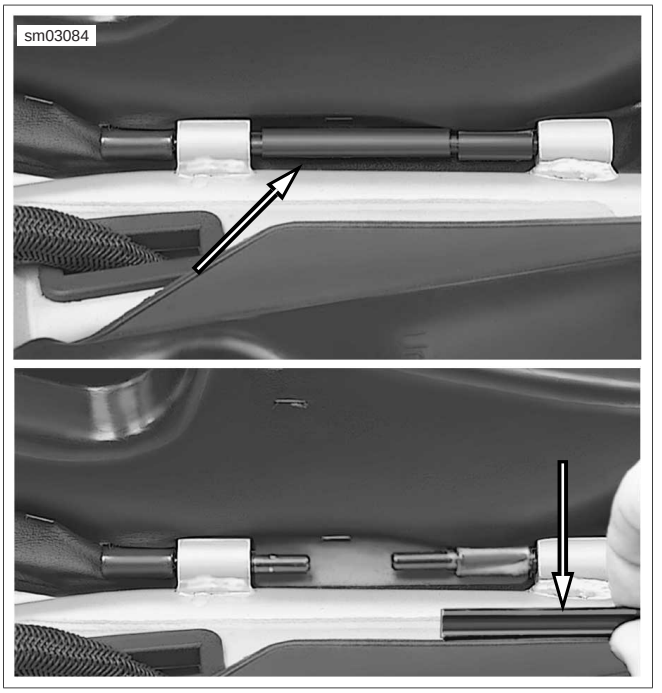



**Figure 2-131. Seat Hinge and Clip (typical)**

## REMOVAL

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove right side cover.
2. Remove maxi-fuse.
3. Remove tail light.
4. Open seat.

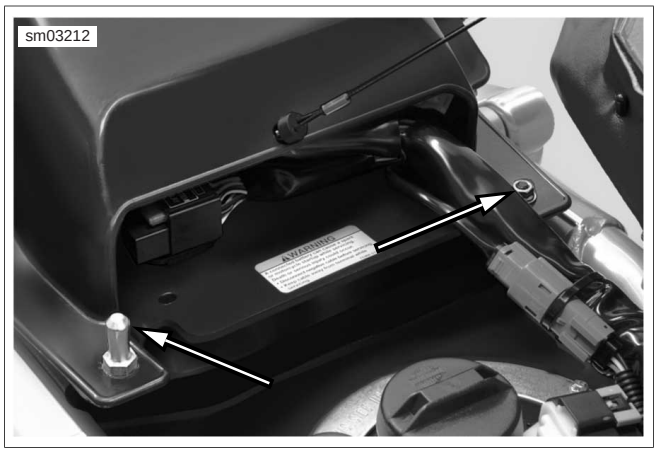



**Figure 2-132. Remove Pillion**

5. See Figure 2-132. Remove fasteners and passenger pillion.

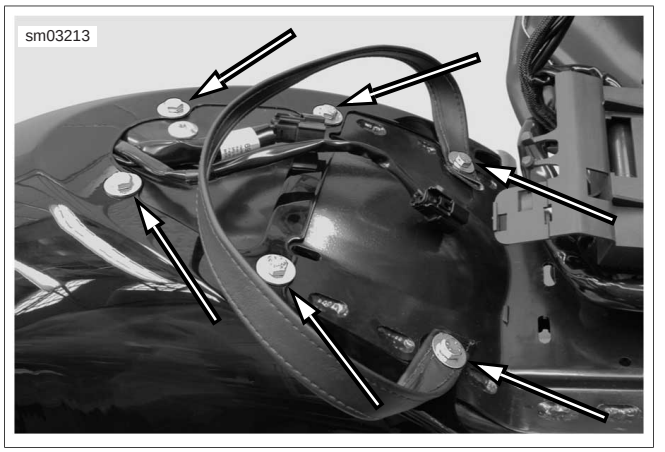
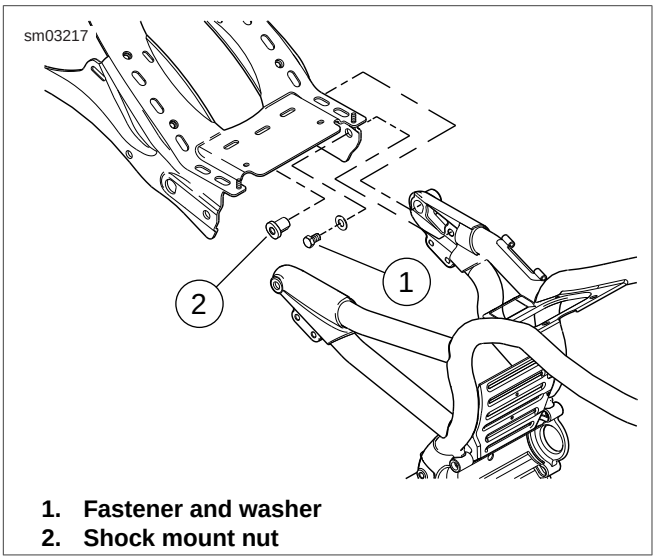



**Figure 2-133. Fender Mounting Fasteners**

6. See Figure 2-133. Remove electrical caddy and six fasteners and washers from fender. Remove fender from inner fender by lifting upward and sliding fender back.




**1. Fastener and washer**
**2. Shock mount nut**

**Figure 2-134. Inner Fender Fasteners**

7. See Figure 2-134. Remove inner fender by removing rear shocks and fasteners shown.

## INSTALLATION

1. Install inner fender and fasteners. Tighten fasteners to 95-110 Nm (75-81 ft-lbs).
2. Install rear shocks using shock mount nuts and tighten to 115-125 Nm (85-92 ft-lbs).
3. Install rear fender by sliding rear fender into slot on tail light panel and aligning fender with bolt holes on inner fender.
4. Install six fender fasteners. Tighten fasteners to 4.5-7.5 Nm (40-66 **in-lbs**).
5. Install tail light.
6. Install passenger pillion and fasteners. Tighten fasteners to 20-26 Nm (15-19 ft-lbs).
7. Install maxi-fuse.
8. Install right side cover.

**WARNING**

**Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)**

9. Test tail light and signal function.

## CLEANING

**WARNING**

**The jiffy stand locks when placed in the full forward (down) position with vehicle weight on it. If the jiffy stand is not in the full forward (down) position with vehicle weight on it, the vehicle can fall over which could result in death or serious injury. (00006a)**

**WARNING**

**Always park motorcycle on a level, firm surface. An unbalanced motorcycle can fall over, which could result in death or serious injury. (00039a)**

**WARNING**

**Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted, it can contact the road surface causing a loss of vehicle control, which could result in death or serious injury. (00007a)**

1. Block motorcycle underneath frame so both wheels are raised off ground.
2. See Figure 2-136. Inspect leg stop and lock slot in jiffy stand weldment. If covered or plugged with dirt, wipe dirt off with a shop towel and spray catch and mating surface with LOCTITE® AEROSOL ANTI-SEIZE.
3. Move jiffy stand leg forward and back while spraying anti-seize to infuse LOCTITE® AEROSOL ANTI-SEIZE into mating parts.
4. Lubricate jiffy stand with LOCTITE® LUBRIPLATE.
5. Check condition of rubber bumper.




**Figure 2-135. Jiffy Stand**

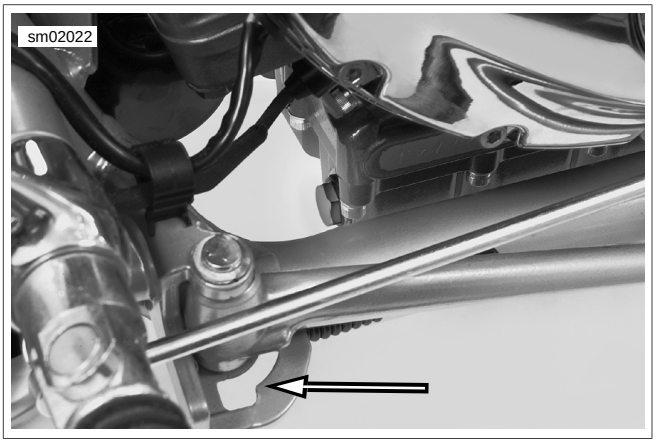



**Figure 2-136. Jiffy Stand Catch and Lock Slot**

## JIFFY STAND INTERLOCK: INTERNATIONAL MODELS

Some international models are equipped with a jiffy stand interlock feature.

If the rider attempts to start the engine or pushes the starter button while the transmission is in gear and the jiffy stand is down, then the jiffy stand interlock system will not permit the engine to run. The message "SidE StAnd" will scroll across the odometer to indicate this to the rider. Raising the jiffy stand (or putting the transmission in neutral) will permit the engine to run and clear the message.

If the jiffy stand falls out of the fully retracted position while riding at speeds greater than 15 km/h (10 mph), then the jiffy stand interlock system will maintain engine operation and alert the rider about this by illuminating the indicators (flash twice) and scroll the message "SidE StAnd" across the odometer. The message will remain until the system detects the jiffy stand in the fully retracted position again. The rider may continue to operate the vehicle while in this mode.

The rider may clear the text messages at any time by pressing the function switch once while the vehicle is powered up.

*NOTE*

*If the operation of raising the jiffy stand and putting the transmission in gear is rapidly executed, the jiffy stand bouncing off the frame could cause the jiffy stand interlock system to activate and stop the engine.*

## REMOVAL

**WARNING**

**Block vehicle under frame such that vehicle will not fall when jiffy stand is removed. Failure to properly block vehicle could result in death or serious injury. (00462b)**

1. Block motorcycle underneath frame so both wheels are raised off ground. Jiffy stand should be able to move through its full range of travel without the weight of motorcycle resting on it.

2. See Figure 2-138. Remove cotter pin (3) from clevis pin (2).

*NOTE*

*Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring tension could cause the spring, attached components and/or hand tools to fly outward.*

3. With leg in the retracted position, detach spring (6) from jiffy stand leg (5), and anchor (7).
4. Remove clevis pin (2) by gently tapping on pin from bottom to drive pin up through mounting bracket.
5. Pull out jiffy stand leg and remove upper and lower bushings.
6. Loosen and remove the anchor (7).
7. Remove rubber bumper (1), if necessary.

*NOTE*

*Jiffy stand brackets can be replaced by replacing the left lower frame rail. See 2.3 FRAME AND LOWER FRAME RAILS.*

## INSTALLATION

1. See Figure 2-138. Apply LOCTITE® 243 (blue) to anchor (7). Install and tighten anchor to 7-9 Nm (62-79 **in-lbs**).
2. Apply LOCTITE® AEROSOL ANTI-SEIZE to both bushings (4) and install bushings in position for a retracted leg.
3. Orient leg retracted in mounting bracket, and install **new** clevis pin (2) through the upper bushing (4), leg (5), and lower bushing (4).
4. Install **new** cotter pin (3).
5. Attach spring (6) to the anchor and to jiffy stand leg (5). When properly installed, spring open hook on anchor faces outward and open hook on jiffy stand leg faces down when jiffy stand leg is extended.
6. Replace rubber bumper (1) if required.
7. Check that jiffy stand operates correctly before supporting the weight of the motorcycle on the leg.

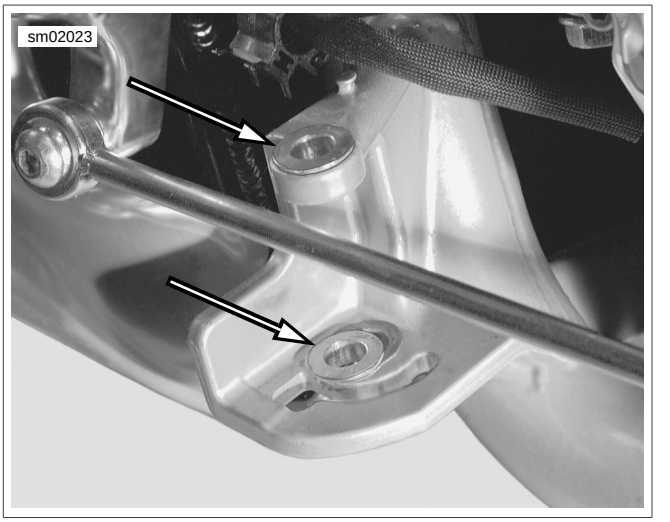
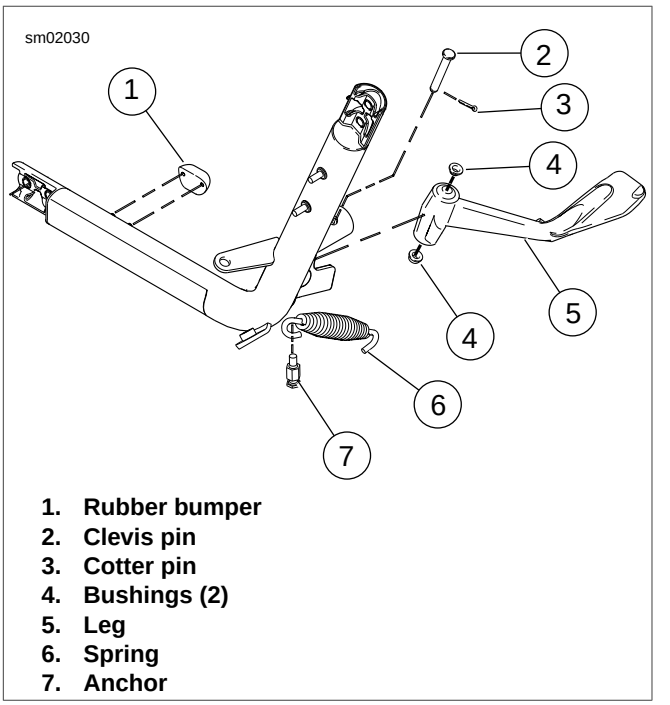



**Figure 2-137. Bushings in Retracted Position**




1. **Rubber bumper**
2. **Clevis pin**
3. **Cotter pin**
4. **Bushings (2)**
5. **Leg**
6. **Spring**
7. **Anchor**

**Figure 2-138. Jiffy Stand Components (typical)**

| SUBJECT | PAGE NO. |
|---|---|
| 3.1 SPECIFICATIONS: ENGINE | 3-1 |
| 3.2 SERVICE WEAR LIMITS | 3-5 |
| 3.3 HOW TO USE THIS SECTION | 3-7 |
| 3.4 OIL FLOW | 3-8 |
| 3.5 OIL PRESSURE | 3-12 |
| 3.6 TROUBLESHOOTING | 3-13 |
| 3.7 STRIPPING MOTORCYCLE FOR SERVICE | 3-15 |
| 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING | 3-17 |
| 3.9 CYLINDER HEAD | 3-34 |
| 3.10 UPPER AND LOWER CRANKCASE SEPARATION | 3-46 |
| 3.11 ENGINE BOTTOM END SERVICE | 3-50 |
| 3.12 OIL PUMP | 3-64 |
| 3.13 OIL FILTER MOUNT | 3-66 |

# NOTES

## GENERAL

**Table 3-1. Cam Drive**

| ITEM | DATA |
|---|---|
| Number of cylinders | 2 |
| Type | 4-cycle, 60°, liquid cooled V-twin |
| Torque (domestic model at crank) | 111.2 Nm (82 ft-lbs) @ 7000 rpm |
| Bore | 105 mm (4.13 in.) |
| Stroke | 72 mm (2.84 in.)72 mm |
| Piston displacement (approx.) | 1250 cc (76 cubic in.) |
| Max. engine speed | 9000 RPM |
| Idle speed | 1250 rpm (1400 rpm Japan) |
| Engine and transmission weight | 89.4 kg (197 lbs) |

**Table 3-2. Oil Pump**

| ITEM | DATA |
|---|---|
| Type | Gerotor, internal oil pump, wet sump |
| Pressure | 3-6.5 bar (43-94 psi) at 3000 RPM and normal operating temperature of 70° C (158° F) |
| Filtration | 10 micron media between pump and engine |

**Table 3-3. Water Pump**

| ITEM | DATA |
|---|---|
| Type | Impeller type, thermostat controlled bypass |

**Table 3-4. Valve Diameter**

| ITEM | MM | IN |
|---|---|---|
| Intake | 40.0 | 1.575 |
| Exhaust | 34.5 | 1.358 |

**Table 3-5. Valve Lash**

| ITEM | | MM | IN |
|---|---|---|---|
| Intake | Max | 0.245 | 0.0096 |
| | Min | 0.195 | 0.0078 |
| Exhaust | Max | 0.345 | 0.0135 |
| | Min | 0.295 | 0.0117 |

**Table 3-6. Cylinder Heads**

| ITEM | MM | IN |
|---|---|---|
| Valve guide in head (interference fit) | Max 0.051 | 0.002 |
| | Min 0.022 | 0.0009 |
| Valve seat in head (interference fit) | Max 0.100 | 0.0039 |
| | Min 0.059 | 0.002 |
| Head gasket surface (flatness) | 0.020 | 0.0008 |
| Valve-to-guide running clearance - intake | Max 0.0585 | 0.0023 |
| | Min 0.0285 | 0.0011 |
| Valve-to-guide running clearance - exhaust | Max 0.0685 | 0.0026 |
| | Min 0.0385 | 0.0015 |
| Valve guide I.D. | Max 6.015 | 0.2368 |
| | Min 6.000 | 0.2362 |
| Valve stem diameter | Intake | |
| | Max 5.9715 | 0.2351 |
| | Min 5.9565 | 0.2345 |
| | Exhaust | |
| | Max 5.9615 | 0.2347 |
| | Min 5.9465 | 0.2341 |
| Valve to guide running clearance | Intake | |
| | Max 0.0585 | 0.0023 |
| | Min 0.0285 | 0.0011 |
| | Exhaust | |
| | Max 0.0685 | 0.0027 |
| | Min 0.0385 | 0.0015 |
| Valve seat to cylinder head press | Max 0.0100 | 0.0004 |
| | Min 0.0590 | 0.0023 |
| Valve seat run-out | Max 0.0050 | 0.0002 |
| Valve seat to guide run-out | Max 0.0200 | 0.0008 |
| Valve spring free length | Outer | |
| | Max 45.630 | 1.797 |
| | Inner | |
| | Max 43.770 | 1.723 |
| Valve spring installed height | Outer | |
| | Max 39.000 | 1.535 |
| | Inner | |
| | Max 37.000 | 1.457 |
| Cylinder head flatness | Max 0.0200 | 0.0008 |
| Intake valve stem protrusion | Max 44.771 | 1.762 |
| | Min 44.171 | 1.739 |
| Exhaust valve stem protrusion | Max 43.893 | 1.728 |
| | Min 43.293 | 1.704 |

**Table 3-6. Cylinder Heads**

| ITEM | MM | IN |
|---|---|---|
| Spring force installed | Outer @ 39 mm (1.535 in.) max | |
| | Max 20.80 | 45.86 |
| | Min 18.97 | 41.88 |
| | Inner @ 37 mm (1.457 in.) max | |
| | Max 11.31 | 24.95 |
| | Min 10.10 | 22.26 |
| Maximally compressed (intake and exhaust) | Outer | |
| | Max 66.58 | 146.80 |
| | Min 60.87 | 134.22 |
| | Inner | |
| | Max 34.15 | 75.31 |
| | Min 31.10 | 68.57 |

**Table 3-7. Cam Drive**

| ITEM | DATA |
|---|---|
| Intake | 112 ± 1° |
| Exhaust | 106 ± 1° |
| Total intake lift | 10.9 mm (0.4291 in.) |
| Duration, intake @ 1 mm | 248° |
| Total exhaust lift | 9.98 mm (0.3929 in.) |
| Duration, exhaust @ 1 mm | 206° |

**Table 3-8. Piston Ring Gap**

| ITEM | DATA |
|---|---|
| Top ring gap (maximum) | 0.550 mm (0.022 in.) |
| Top ring gap (minimum) | 0.350 mm (0.014 in.) |
| 2nd ring gap (maximum) | 0.650 mm (0.026 in.) |
| 2nd ring gap (minimum) | 0.400 mm (0.016 in.) |
| Oil control ring (maximum) | 0.890 mm (0.035 in) |
| Oil control ring (minimum) | 0.380 mm (0.015 in.) |
| Top ring side clearance (maximum) | 0.077 mm (0.003 in.) |
| Top ring side clearance (minimum) | 0.032 mm (0.001 in.) |
| 2nd ring side clearance (maximum) | 0.075 mm (0.003 in.) |
| 2nd ring side clearance (minimum) | 0.030 mm (0.001 in.) |

**Table 3-9. Connecting Rod/Piston**

| ITEM | MM | IN |
|---|---|---|
| Rod small end bore dia. | Max 22.028 | 0.8672 |
| | Min 22.018 | 0.8669 |
| Piston pin diameter | Max 22.000 | 0.8661 |
| | Min 21.995 | 0.8659 |

**Table 3-9. Connecting Rod/Piston**

| ITEM | MM | IN |
|---|---|---|
| Running clearance | Max 0.033 | 0.0013 |
| | Min 0.018 | 0.0007 |

**Table 3-10. Balance Shaft/Crankcase**

| | MM | IN |
|---|---|---|
| Balance shaft journal | Max 17.012 | 0.6698 |
| | Min 17.001 | 0.6693 |
| Press fit inner race to journal | Max -0.020 | - 0.0008 |
| | Min -0.001 | - 0.0000 |
| Crankcase balance shaft bearing bore | Max 39.971 | 1.5737 |
| | Min 39.955 | 1.5730 |
| Bearing outer race to bearing bore press fit | Max -0.045 | - 0.0018 |
| | Min -0.018 | - 0.0007 |

**Table 3-11. Connecting Rod Journals**

| ITEM | MM | IN |
|---|---|---|
| Rod bearing journal | Red | |
| | Max 47.991 | 1.8894 |
| | Min 47.983 | 1.8891 |
| | Blue | |
| | Max 47.983 | 1.8891 |
| | Min 47.975 | 1.8888 |
| Rod bearing bore without bearing | Max 51.616 | 2.0321 |
| | Min 51.600 | 2.0315 |
| Rod bearing bore with bearing | Red | |
| | Max 48.052 | 1.8918 |
| | Min 48.020 | 1.8906 |
| | Blue | |
| | Max 48.044 | 1.8915 |
| | Min 48.012 | 1.890 |
| Running clearance | Max 0.069 | 0.0027 |
| | Min 0.029 | 0.0011 |
| Axial end play | Max 0.290 | 0.0114 |
| | Min 0.140 | 0.0055 |

**Table 3-12. Crankshaft/Crankcase**

| ITEM | ALTERNATOR SIDE | | CLUTCH SIDE | |
|---|---|---|---|---|
| | MM | IN | MM | IN |
| Main bearing journal | Blue | | | |
| | Max 55.977 | 2.20382 | Max 55.952 | 2.20283 |
| | Min 55.971 | 2.20358 | Min 55.946 | 2.20260 |
| | Green | | | |
| | Max 55.984 | 2.20409 | Max 55.959 | 2.20311 |
| | Min 55.977 | 2.20382 | Min 55.952 | 2.20283 |
| | Red | | | |
| | Max 55.990 | 2.20433 | Max 55.965 | 2.20334 |
| | Min 55.984 | 2.20410 | Min 55.959 | 2.20312 |
| Main bearing bore | Max 61.019 | 2.40232 | | |
| | Min 61.000 | 2.40158 | | |
| Running clearance | Blue | | | |
| | Max 0.059 | 0.00232 | Max 0.059 | 0.00232 |
| | Min 0.026 | 0.00103 | Min 0.026 | 0.00103 |
| | Green | | | |
| | Max 0.061 | 0.00240 | Max 0.061 | 0.00240 |
| | Min 0.027 | 0.00107 | Min 0.027 | 0.00107 |
| | Red | | | |
| | Max 0.062 | 0.00244 | Max 0.062 | 0.00244 |
| | Min 0.029 | 0.00115 | Min 0.029 | 0.00115 |
| Axial end play | Max 0.060 | 0.00236 | | |
| | Min 0.050 | 0.00197 | | |

## GENERAL

Wear limits are given here as a guideline for measuring used engine components. Replace components when they exceed values listed here.

**Table 3-13. Crankshaft/Crankcase**

| ITEM | ALTERNATOR SIDE | | CLUTCH SIDE | |
|---|---|---|---|---|
| | MM | IN | MM | IN |
| Main bearing journal | Blue | | | |
| | Max 55.977 | 2.20382 | Max 55.952 | 2.20283 |
| | Min 55.971 | 2.20358 | Min 55.946 | 2.20260 |
| | Green | | | |
| | Max 55.984 | 2.20409 | Max 55.959 | 2.20311 |
| | Min 55.977 | 2.20382 | Min 55.952 | 2.20283 |
| | Red | | | |
| | Max 55.990 | 2.20433 | Max 55.965 | 2.20334 |
| | Min 55.984 | 2.20410 | Min 55.959 | 2.20312 |
| Main bearing bore | Max 61.019 | 2.40232 | | |
| | Min 61.000 | 2.40158 | | |
| Running clearance | Blue | | | |
| | Max 0.059 | 0.00232 | Max 0.059 | 0.00232 |
| | Min 0.026 | 0.00103 | Min 0.026 | 0.00103 |
| | Green | | | |
| | Max 0.061 | 0.00240 | Max 0.061 | 0.00240 |
| | Min 0.027 | 0.00107 | Min 0.027 | 0.00107 |
| | Red | | | |
| | Max 0.062 | 0.00244 | Max 0.062 | 0.00244 |
| | Min 0.029 | 0.00115 | Min 0.029 | 0.00115 |
| Axial end play | Max 0.060 | 0.00236 | | |
| | Min 0.050 | 0.00197 | | |

**Table 3-14. Crankshaft/Crankcase**

| ITEM | MM | IN |
|---|---|---|
| Main bearing journal | 55.940 | 2.202 |
| Axial end play | 0.300 | 0.011 |
| Main bearing bore | 61.019 | 2.4023 |

**Table 3-15. Connecting Rod/Piston**

| ITEM | REPLACE IF WEAR EXCEEDS | |
|---|---|---|
| | MM | IN |
| Small end bore diameter | 22.050 | 0.868 |
| Piston pin diameter | 21.996 | 0.866 |

**Table 3-16. Connecting Rod/Crankshaft**

| ITEM | REPLACE IF WEAR EXCEEDS | |
|---|---|---|
| | MM | IN |
| Rod bearing journal | 47.970 | 1.888 |
| Rod bearing bore | 51.616 | 2.0321 |

**Table 3-17. Piston/Cylinder Liner**

| ITEM | REPLACE IF WEAR EXCEEDS | |
|---|---|---|
| | MM | IN |
| Cylinder liner i. d. bore (freestate) | 105.085 | 4.1372 |
| Cylinder liner out-of-round (installed) | 0.080 | 0.0031 |
| Piston major diameter | 104.925 | 4.1309 |
| Running clearance | 0.080 | 0.0031 |

**Table 3-18. Piston Rings**

| ITEM | REPLACE IF WEAR EXCEEDS | |
|---|---|---|
| | MM | IN |
| Top ring gap | 0.700 | 0.0276 |
| 2nd ring gap | 0.800 | 0.03419 |
| Oil control ring gap | 1.050 | 0.0413 |
| Top ring side clearance | 0.100 | 0.0039 |
| 2nd ring side clearance | 0.070 | 0.0028 |

**Table 3-19. Cylinder Heads**

| ITEM | REPLACE IF WEAR EXCEEDS | |
|---|---|---|
| | MM | IN |
| Cylinder head flatness | 0.100 | 0.0039 |
| Cylinder head cam bore diameter | 26.035 | 1.0250 |
| Tappet bucket o.d. diameter | 30.962 | 1.2190 |
| Cylinder head bucket bore diameter | 31.040 | 1.2220 |
| Valve guide i.d. diameter | 6.040 | 0.2378 |
| Valve stem deflection | 0.08 | 0.00315 |
| Valve seat width - intake | 1.700 | 0.0669 |
| Valve seat width - exhaust | 2.00 | 0.0787 |
| Valve seat-to-guide runout | 0.080 | 0.0031 |

## TOP END REPAIR

Valve lash adjustment and secondary cam chain adjustment can be done with engine in chassis. Cam drive inspection and some part replacement can be done with the engine in chassis.

For all other top end repairs, the engine must be removed from the chassis. See 2.7 ENGINE REPLACEMENT.

## BOTTOM END REPAIR

Bottom end repair can only be done with engine removed from chassis. See 2.7 ENGINE REPLACEMENT.

## TYPICAL SYMPTOMS

Symptoms indicating a need for engine repair are often misleading, but generally if more than one symptom is present, possible causes can be narrowed down to make at least a partial diagnosis. An above normal consumption of oil, for example, could be caused by several mechanical faults. But when accompanied by a blue-gray smoke from the exhaust, and when low compression is present, it indicates the rings need replacing. Low compression by itself, however, indicates improperly seated valves, not worn rings.

Certain "knocking" noises may be caused by loose bearings, others by piston slap, a condition where piston or cylinder or both out of tolerance, allowing the piston to slap from front to rear of the cylinder as it moves up and down.

Most frequently, valves, rings, piston pins, bushings, and bearings need attention at about the same time. If the symptoms can be narrowed down through the process of elimination to indicate that any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

## GENERAL

The engine oil serves two purposes. First, the oil lubricates all of the metal to metal parts that are in motion relative to each other. Second, the oil cools the engine, specifically, the pistons.

See Figure 3-1. As the oil is warmed to normal operating temperature, the oil is scavenged from the sump at the screened pick up (1) by the oil pump (2).

The oil pump (2) pressurizes the oil and the pressure maintains the flow of oil through the engine. The oil flows through a bypass valve and through the oil passages to the oil filter (3). If oil pressure exceeds 88 psi, the bypass valve is activated, rerouting oil back through the suction side of the oil pump.

The filtered oil flows into the oil lines up and over the top of the radiator/oil cooler assembly (via oil line) and down to the left side of the oil cooler (4). Flowing through the cooler, the cooled oil is routed up and over the radiator/oil cooler assembly (via oil line) and then down to the oil fitting (5) on the front of the crankcase.

At the crankcase oil fitting, oil is routed to three passages:

1. Oil entering the passage (6) on the water pump side lubricates the right main bearings. The oil flows in a groove in the main bearing then through a drilled hole in the crankshaft to lubricate the rear connecting rod journals.
2. Oil entering the middle passage (7) supplies oil to the front piston jet. The piston jets spray oil to cool the underside of the pistons.
3. See Figure 3-2. Oil entering the cam drive side passage (8) feeds the cam drive side main bearing. The oil flows in a groove in the main bearing then through a drilled hole in the crankshaft to lubricate the front connecting rod bearings.
4. From the cam drive side main bearing, the oil is routed in two directions:
   a. Oil is routed up to the cam drive triple gear bushing (9) where oil is routed along the shaft to the water pump impeller. The oil also flows to front cylinder head through an oil sending unit (10) which shuts off the oil pressure light when oil pressure reaches 13.8-34.5 kPa (2-5 psi). The oil passages continue on to the intake and exhaust cams (13) lubricating the cam journals through grooves in the bearings and to the secondary cam chain tensioner (12).
   b. The second set of passages from the cam drive side main bearings lead the oil flow to the primary cam chain tensioner and up to the secondary cam chain tensioner, the rear cylinder head and the rear intake and exhaust cam journals. From the primary cam chain tensioner the oil also branches to the rear piston jet to cool the underside of the rear piston. The final passages from the cam drive side main bearing routes oil back to the transmission and clutch where the oil lubricates and cools the transmission input and output shafts.
5. See Figure 3-3. Returning oil to the sump (19), the rear cylinder head drains onto the clutch (16) to lubricate primary gear and clutch assembly. Oil from the rear cylinder head also drains on the transmission input and output shaft gearset (16) where gear meshing transfers oil to all gears and then drains into the oil sump (17).
6. The oil in the front cylinder head drains down the cylinder head drain passage (18) to the sump (19).

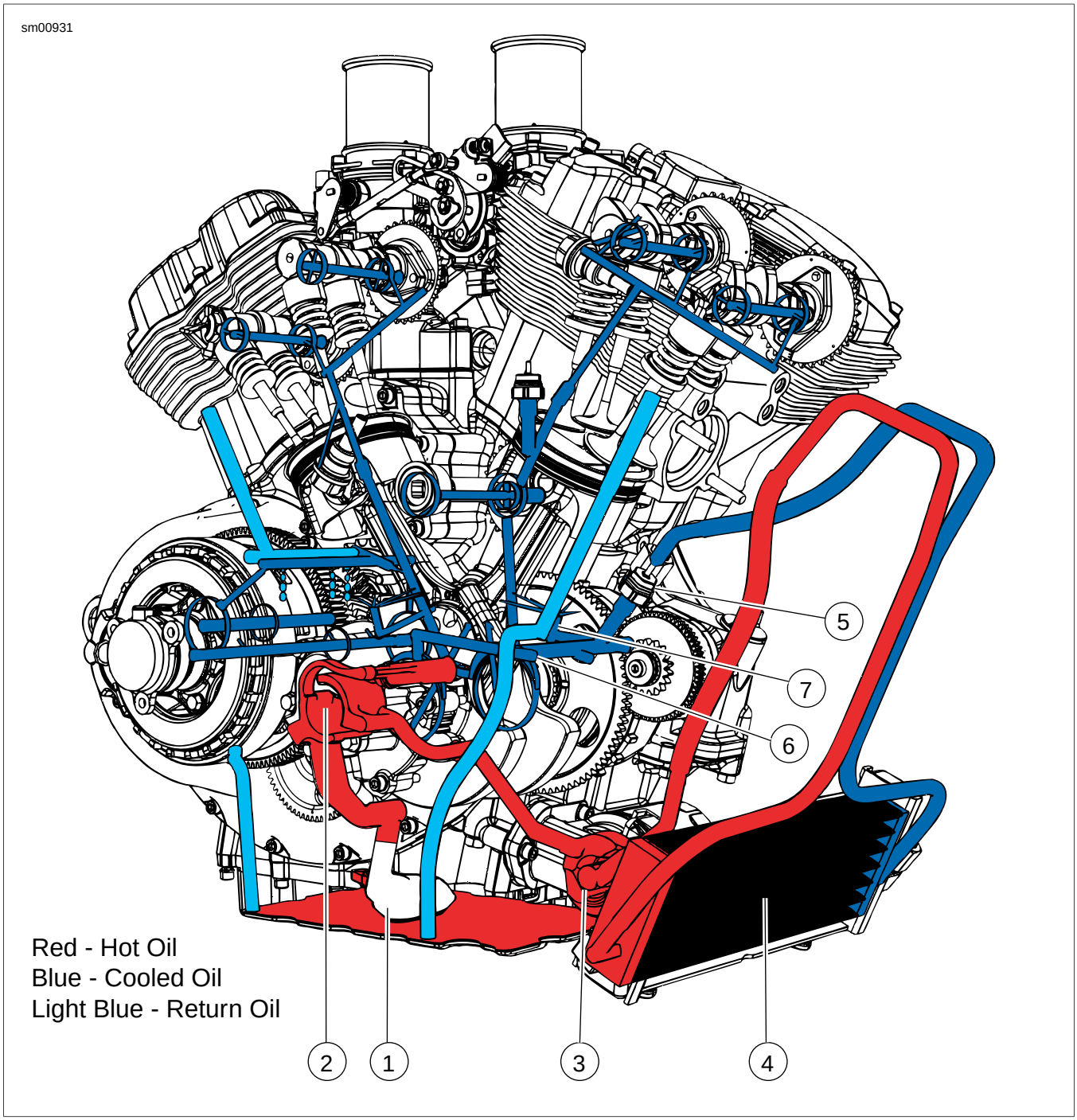



**Figure 3-1. Oil Flow A**

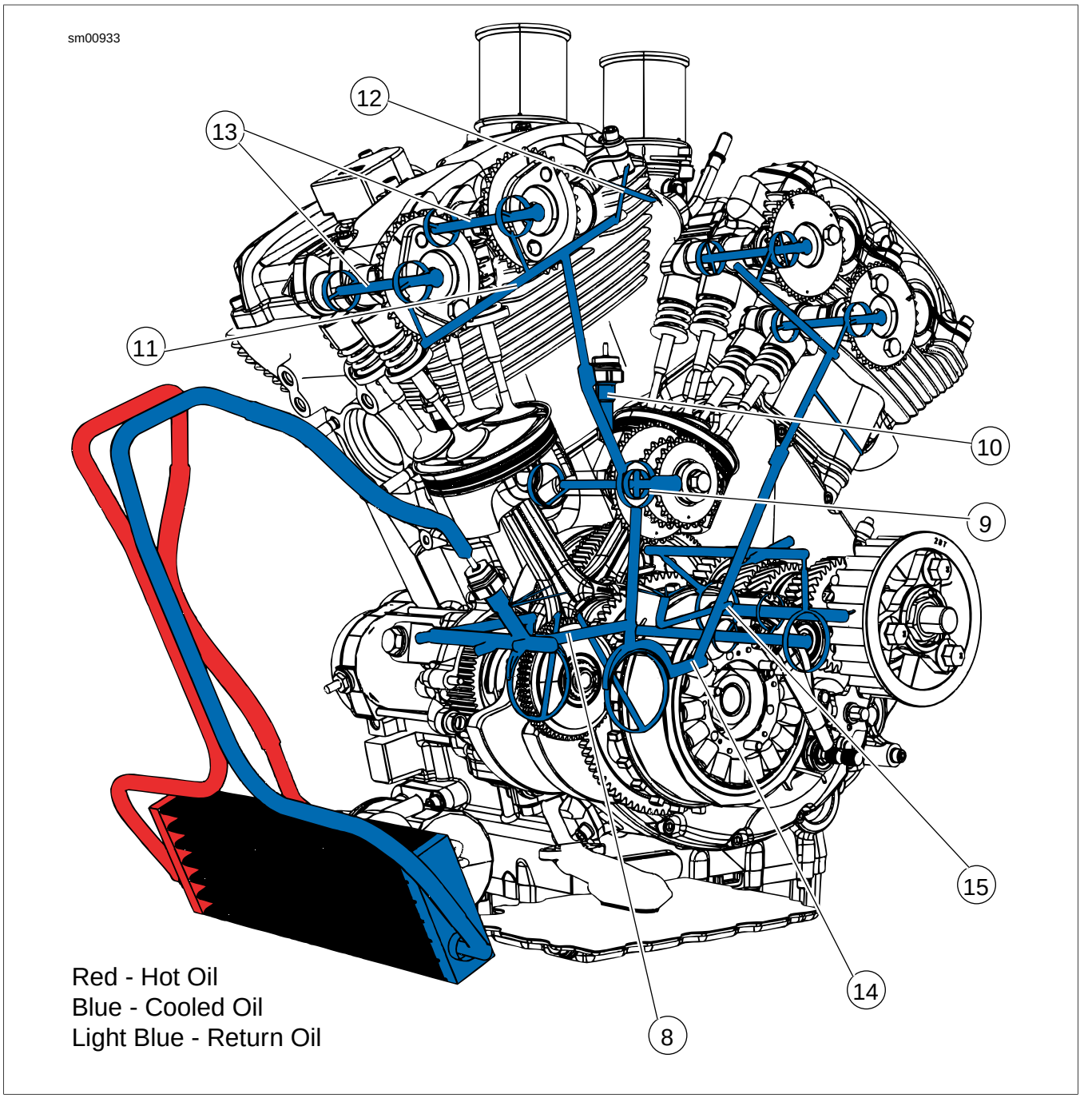



**Figure 3-2. Oil Flow B**

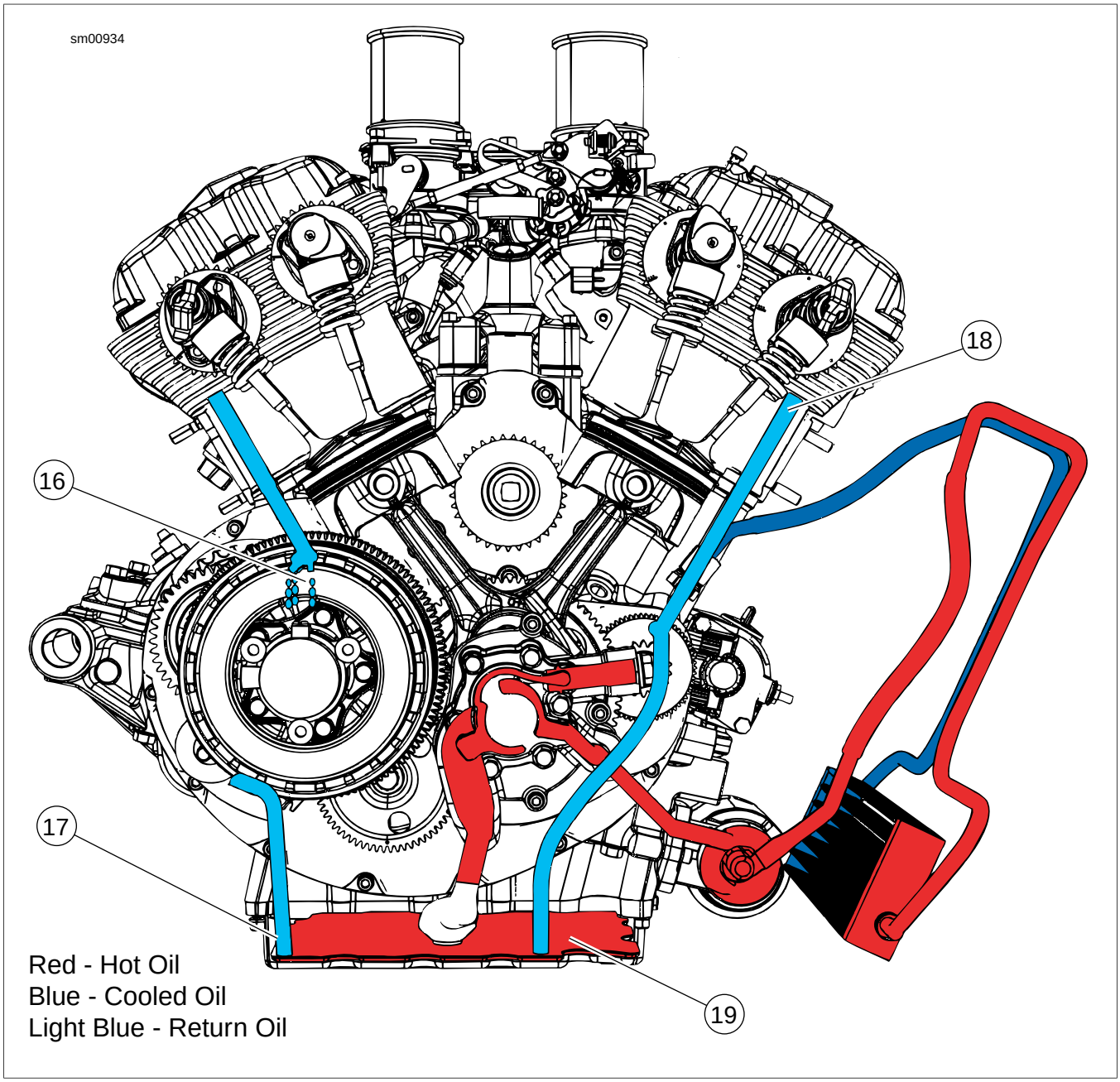



**Figure 3-3. Oil Flow C**

## OIL PRESSURE INDICATOR LAMP

See Figure 3-4. The red oil pressure indicator lamp illuminates to indicate improper circulation of the engine oil. The lamp illuminates when the ignition is first turned on (before the engine is started), but should be extinguished once the engine is running.

**CAUTION**

**If the oil pressure indicator lamp remains lit, always check the oil supply first. If the oil supply is normal and the lamp is still lit, stop the engine at once and do not ride further until the trouble is located and the necessary repairs are made. Failure to do so may result in engine damage. (00157a)**

If the indicator lamp is not extinguished, it may be the result of a low oil level or diluted oil supply. A defect in the lamp wiring, faulty oil pressure sending unit, damaged oil pump, plugged oil filter element, incorrect oil viscosity, broken or weak spring in the oil pressure relief valve and/or damaged or incorrectly installed o-rings in the engine may also cause the indicator lamp to remain on.

To troubleshoot the problem, always check the engine oil level first. If the oil level is OK, check oil pressure.

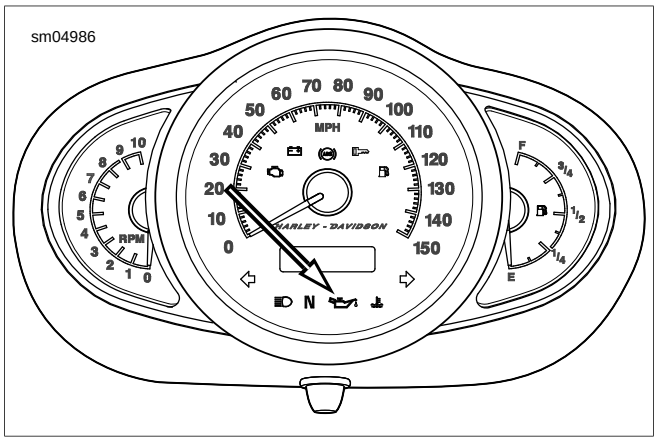



**Figure 3-4. Oil Pressure Indicator Lamp (typical)**

## CHECKING OIL PRESSURE

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45308 | OIL PRESSURE GAUGE |
| HD-45309 | ADAPTER |

Operating oil pressure is checked as follows:

1. Fill crankcase to proper level.

*NOTE*

*Remove MAP sensor and horn for additional clearance if needed.*

2. Remove oil pressure switch from crankcase.
3. Attach OIL PRESSURE GAUGE (Part No. HD-45308) to ADAPTER (Part No. HD-45309).
4. Install in oil pressure switch mounting hole.

*NOTES*

- *When checking oil pressure after engine rebuild, unplug fuel pump connector at fuel pump to verify oil pressure before engine starts.*
- *Engine oil should be at normal operating temperature 70° C (158° F) for an accurate reading.*

5. Oil pressure should be 3-6.5 bar (43-94 psi) at 3000 RPM and normal operating temperature of 70° C (158° F).

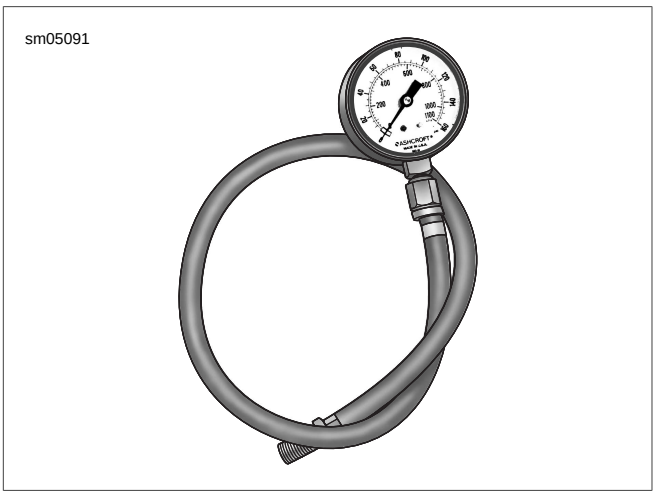



**Figure 3-5. Oil Pressure Gauge (HD-45308)**

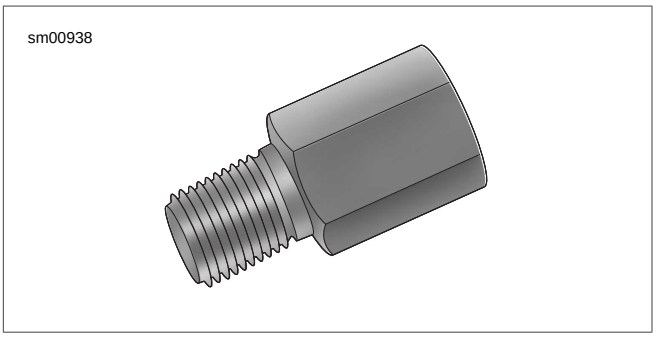



**Figure 3-6. Oil Pressure Gauge Adapter (HD-43509)**

## COMPRESSION TEST

| PART NUMBER | TOOL NAME |
|---|---|
| HD-33223-1 | CYLINDER COMPRESSION GAUGE |

Satisfactory engine performance depends upon a mechanically sound engine. In many cases, unsatisfactory performance is caused by combustion chamber leakage. A compression test can help determine the source of cylinder leakage. Use CYLINDER COMPRESSION GAUGE (Part No. HD-33223-1) that has a screw-in type adapter.

A proper compression test should be performed with the engine at normal operating temperature when possible.

1. See 1.5 AIR CLEANER AND EXHAUST SYSTEM, 1.9 BATTERY MAINTENANCE, and 1.22 SPARK PLUGS AND COIL.
2. Connect compression tester to front cylinder per manufacturer's instructions.
3. Reinstall battery.
4. Make sure transmission is in neutral. With throttle plates in wide open position, crank engine continuously through 5 to 7 full compression strokes.
5. Note gauge readings at the end of the first and last compression strokes. Record test results.
6. Repeat steps 2 through 5 on rear cylinder.
7. Review test results. Final compression reading should be at least 13.78 bar (200 psi) with no more than a ten percent variance between front and rear cylinders.
8. If compression of a cylinder does not fall within its upper and lower limits, refer to Table 3-20.

**Table 3-20. Compression Test Results**

| TEST RESULTS | DIAGNOSIS |
|---|---|
| Compression low on first stroke, builds up on the following strokes, but does not reach normal. Improves considerably when oil is added to cylinder. | Ring trouble |
| Compression low on first stroke, does not build up much on following strokes. Does not improve considerably with the addition of oil. Verify valve lash. | Valve trouble |
| Same results as valve trouble. | Head gasket leak |

9. To verify worn piston rings, inject approximately 15 ml (1/2 oz) engine oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

*NOTE*

*After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.*

## DIAGNOSING VALVE TRAIN NOISE

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45334 | SECONDARY CAM CHAIN MEASUREMENT TOOL |

To diagnose and correct noisy valve train components, use the following procedures:

1. Visually inspect camshaft lobes for abnormal wear. See 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Camshaft Inspection.
2. If there is noise and engine has low oil pressure, drop oil pan and inspect for metal debris.
3. On high mileage engines with good oil pressure, if there is a noise at start-up which goes away, use SECONDARY CAM CHAIN MEASUREMENT TOOL (Part No. HD-45334) to check cam chain wear. See 1.26 SECONDARY CAM CHAIN.
4. Verify valve lash. See 1.25 VALVE LASH.

## CYLINDER LEAKAGE TEST

| PART NUMBER | TOOL NAME |
|---|---|
| HD-35667A | CYLINDER LEAKDOWN TESTER |
| HD-45314 | CRANKSHAFT ROTATING WRENCH |

The cylinder leakage test will pinpoint engine problems including leaking valves, worn, broken or stuck piston rings and blown head gaskets. The cylinder leakage tester applies compressed air to the cylinder at a controlled pressure and volume and measures the percent of leakage from the cylinder.

Use CYLINDER LEAKDOWN TESTER (Part No. HD-35667A) and 12 mm adapter and follow the instructions supplied with the tester.

1. Run engine to normal operating temperature.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Remove alternator inspection derby cover.
4. Remove airbox cover, air filter top and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

5. Hold throttle wide open to observe the front cylinder intake valve through the intake port.
6. Turn engine over in direction of operation with CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) Open the valve fully, then close. When the intake valve has

closed on the valve seat, turn the engine an additional 1/4 turn.

7. Slowly continue to turn the engine an additional 1/8th turn, the front cylinder is now close to TDC.
8. To keep the engine from turning over when air pressure is applied to the cylinder, engage transmission in fifth gear and lock the rear brake and hold engine with crankshaft rotating wrench if needed.

*NOTE*

*Before performing the cylinder leakage test, verify that the tester itself is free from leakage to obtain the most accurate test results. With a soap solution (applied around all tester fittings), connect the cylinder leakdown tester to the compressed air source and look for any bubbles that would indicate leakage from the tester.*

9. Following the manufacturer's instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent of leakage. Leakage greater than 15% indicates internal engine problems.
10. Listen for air leaks at throttle body, exhaust pipe, head gasket and crankcase breather. Air escaping through the throttle body indicates a leaking intake valve. Air escaping through the exhaust pipe indicates a leaking exhaust valve.

*NOTE*

*If air is escaping through valves, measure and adjust valve lash as required. See 1.25 VALVE LASH.*

11. Repeat procedure on rear cylinder.

*NOTE*

*After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.*

## DIAGNOSING SMOKING ENGINE OR HIGH OIL CONSUMPTION

Perform 3.6 TROUBLESHOOTING, Compression Test or 3.6 TROUBLESHOOTING, Cylinder Leakage Test as described. If further testing is needed, remove suspect head(s) and inspect for the following:

### Check Prior to Cylinder Head Removal

1. Crankcase overfilled.
2. Oil carryover.
3. Breather hose restricted.
4. Restricted oil filter.

### Check After Cylinder Head Removal

1. Valve guide seals.
2. Valve guide to valve stem clearance.
3. Gasket surface of both head and cylinder.
4. Cylinder head casting's porosity allowing oil to drain into combustion chamber.
5. Piston/ring failure.

## GENERAL

*NOTE*

*If cylinder head, crankcase, or transmission work needs to be performed, engine must be removed from chassis.*

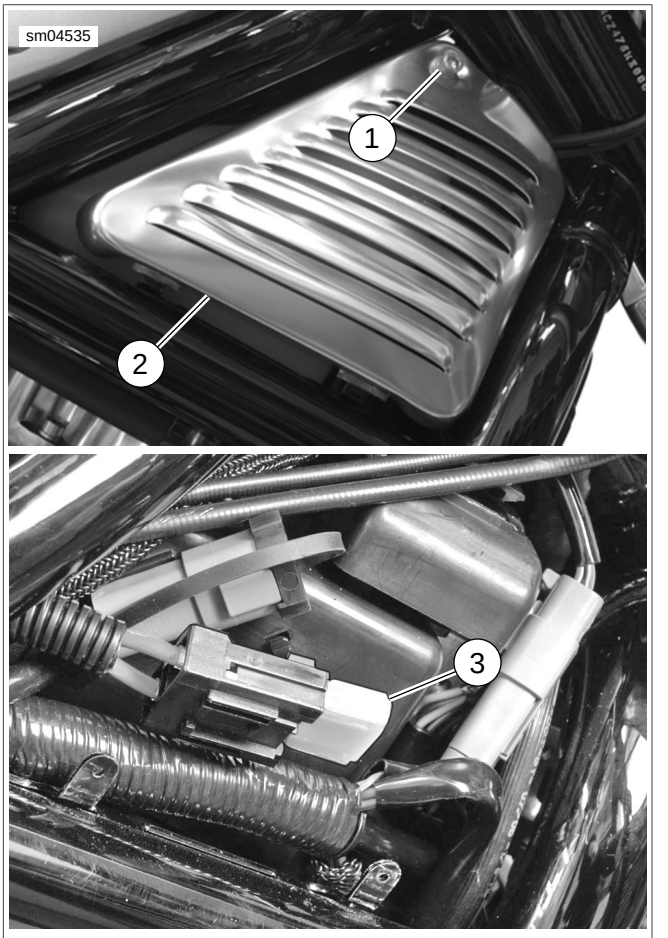
1. If engine is to be removed, position motorcycle on a lift with side extensions.
2. See Figure 3-7. Remove right side cover.
3. Remove maxi-fuse.
4. Remove the engine. See 2.7 ENGINE REPLACEMENT.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

**⚠WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**




1. **Fastener**
2. **Side cover**
3. **Maxi-Fuse (40 amp)**

**Figure 3-7. Maxi-Fuse**

## ENGINE CRADLE AND STAND

| PART NUMBER | TOOL NAME |
|---|---|
| HD-42310 | ENGINE TRANSMISSION STAND |
| HD-42310-100 | CRADLE LOCKING NUT AND SPACER |
| HD-42310-100 | CRADLE LOCKING NUT AND SPACER RING |
| HD-42310-40 | ENGINE CRADLE |
| HD-43646-A | ROLLING ENGINE STAND |
| HD-43646-A | ROLLING ENGINE STAND |

Prior to engine service, all fluids should be drained from the engine and the engine removed from the chassis.

To support the engine, use ENGINE CRADLE (Part No. HD-42310-40) mounted to ENGINE TRANSMISSION STAND (Part No. HD-42310) for bench work or to ROLLING ENGINE STAND (Part No. HD-43646-A) for floor work.

The engine cradle is bolted to threaded holes in the front and rear of the upper engine case.

1. See Figure 3-8. Using fasteners provided, install ENGINE CRADLE to rear of upper engine case.
2. Install fasteners at front of engine.
3. With engine securely strapped, hoist engine and cradle to ENGINE/TRANSMISSION STAND and slide cradle shaft into post of stand.
4. See Figure 3-9. If mounting to ROLLING ENGINE STAND, slide spacer ring from CRADLE LOCKING NUT AND SPACER (Part No. HD-42310-100) on cradle shaft before mounting to stand.

*NOTE*

*The spacer ring is used only when securing the cradle to the ROLLING ENGINE STAND (Part No. HD-43646-A)*

5. Rotate engine and cradle to align holes in cradle shaft to holes in stand post and secure with locking pin.
6. See Figure 3-10. Install fastener and handle from CRADLE LOCKING NUT AND SPACER RING (Part No. HD-42310-100) .
7. To access engine components from different angles, remove locking pin, rotate cradle and engine, align holes closest to desired angle and insert locking pin to secure.

*NOTE*

*Dirt caked on fins and other areas can fall into crankcase bore or stick to subassemblies as parts are removed. Abrasive particles can damage machined surfaces or plug oil passage-ways. Remove all dirt and particles before disassembly to prevent component damage.*

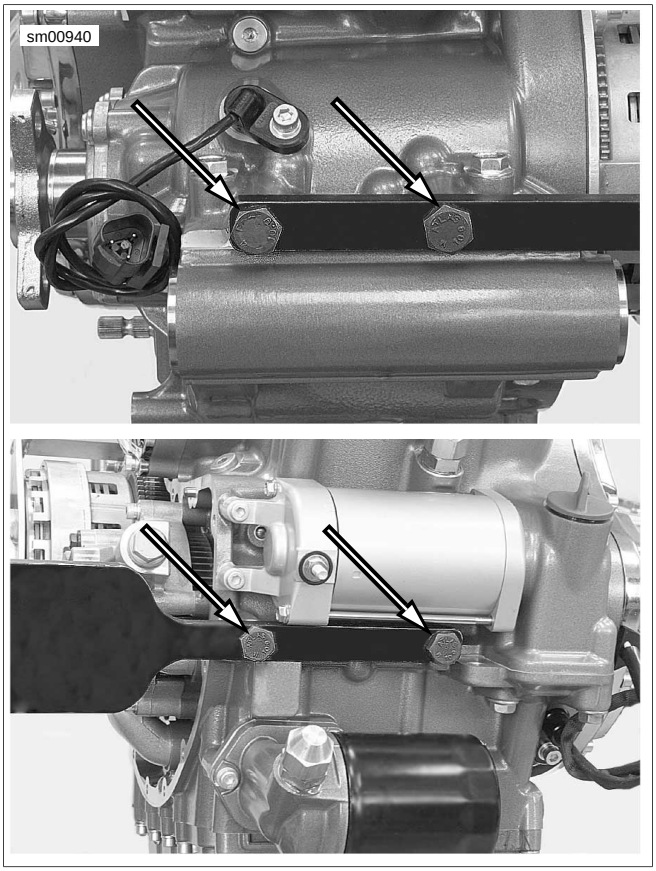



**Figure 3-8. Cradle Fasteners in Upper Engine Case**

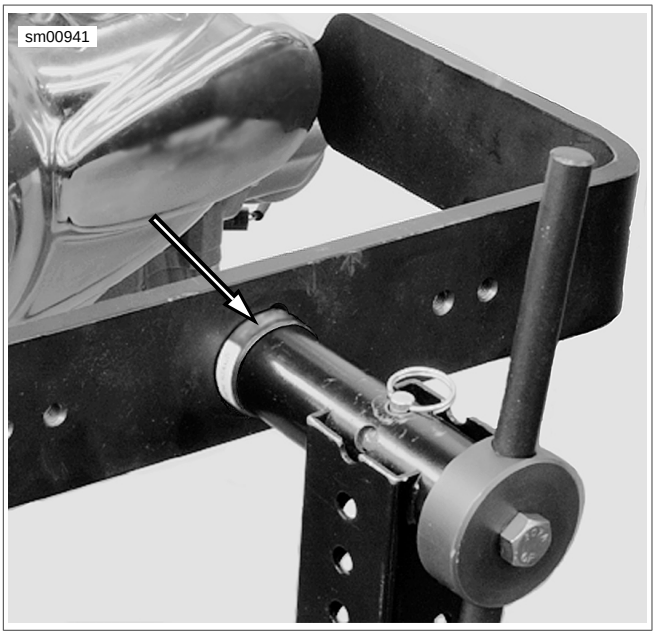



**Figure 3-9. Spacer Ring**

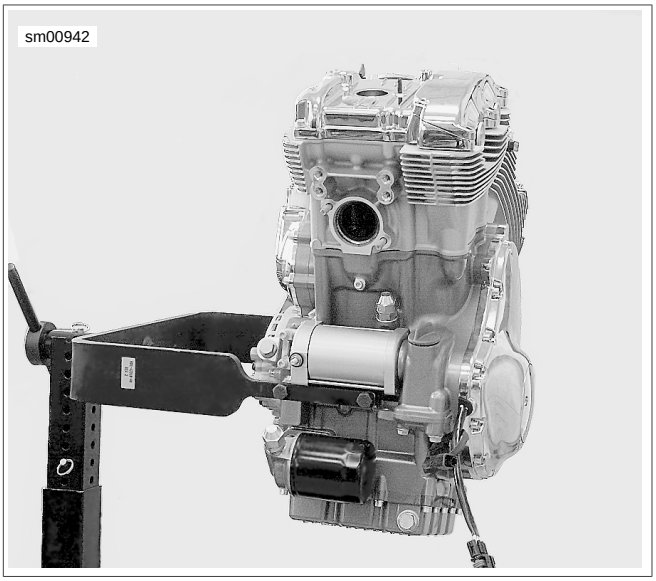



**Figure 3-10. Engine in Cradle and Rolling Stand**

## GENERAL

This section provides information on removal and installation of the timing chains, camshafts, and timing of the cam system.

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45306 | CRANKSHAFT LOCKING PIN |
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45315 | ALTERNATOR ROTOR REMOVER |
| HD-45491 | TAPPET COMPRESSSING TOOL |
| HD-45653 | TDC POSITIONING TOOL |

1. Remove clutch cover and oil pump assembly.
2. Remove alternator cover. See 8.13 ALTERNATOR.
3. Remove plug top coils and spark plugs. See 1.22 SPARK PLUGS AND COIL.
4. See Figure 3-11. Remove cam cover fasteners in reverse order of torque sequence and remove cam covers.
5. See Figure 3-12. Install TDC POSITIONING TOOL (Part No. HD-45653) in front spark plug hole.

*NOTE*

*Never insert a foreign object, such as a screwdriver, in the spark plug hole. Engine damage can result.*

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

6. Using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) rotate the engine counter-clockwise (direction of operation). Note when exhaust valve is closing (TDC positioning tool will start to extend as valve closes) and engine is approaching TDC.
7. See Figure 3-13. When the TDC reference tool is fully extended, remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (Part No. HD-45306) .
8. The crankshaft locking pin should insert flush with engine case. It may be necessary to gently rock the crankshaft using the CRANKSHAFT ROTATING WRENCH to lock engine at exact TDC.
9. Verify cam timing. See 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing.
10. Remove TDC POSITIONING TOOL and CRANKSHAFT LOCKING PIN.

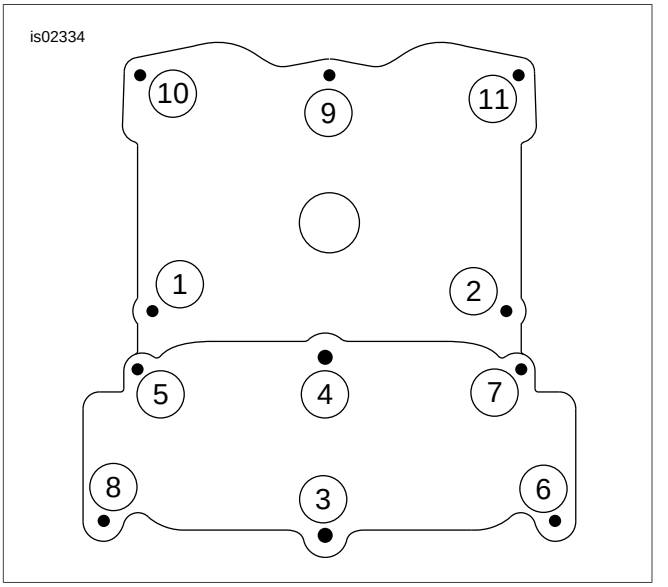



**Figure 3-11. Cam Cover Torque Sequence**

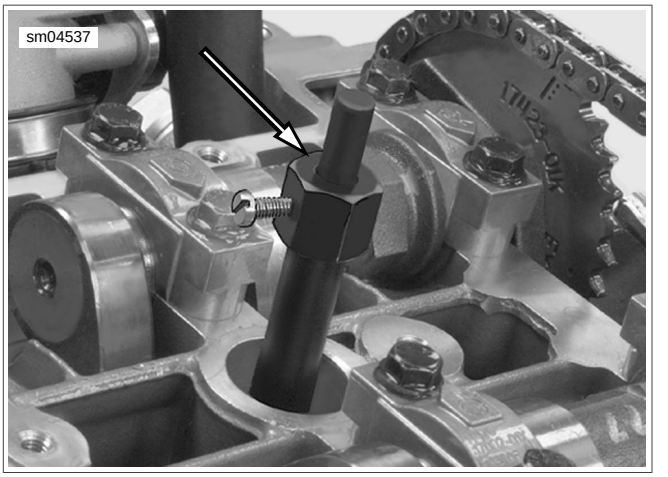



**Figure 3-12. Top Dead Center Positioning Tool**




**Figure 3-13. Crankshaft Locking Pin (HD-45306)**

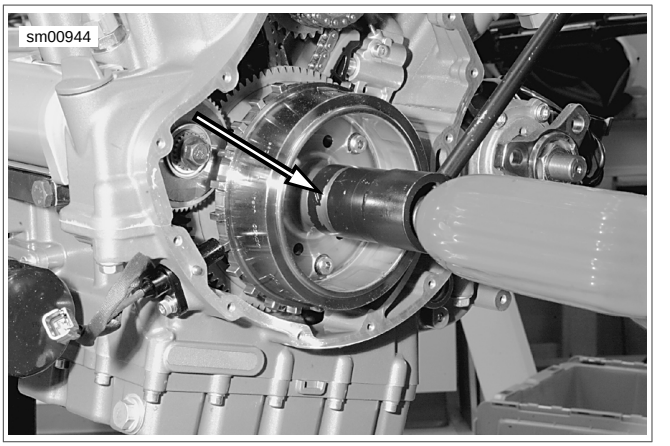



**Figure 3-14. Rotor Fastener**

11. See Figure 3-14. Holding 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH, (or 1/2 inch breaker bar and short extension on crank gear), loosen rotor fastener. Air impact tool may be used for REMOVAL ONLY.
12. See Figure 3-15. Holding 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH, loosen starter limiter fastener.
13. See Figure 3-16. Loosen triple sprocket fastener.
14. See Figure 3-17. Install ALTERNATOR ROTOR REMOVER (Part No. HD-45315) and finger tighten.
15. Use an impact socket and wrench to tighten the tool to remove the rotor and the ball clutch from the crankshaft taper. Use a light duty air impact wrench if necessary.

*NOTE*

*Use caution not to drop the rotor shell during removal process.*

16. See Figure 3-18. Remove starter limiter fastener and starter limiter gear assembly. Remove starter limiter fastener and starter limiter gear assembly.

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

17. See Figure 3-19. Remove snap ring from crankshaft.

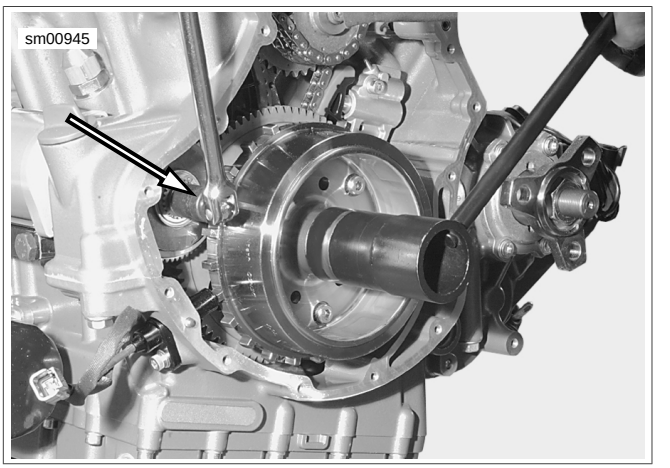



**Figure 3-15. Starter Limiter Fastener**

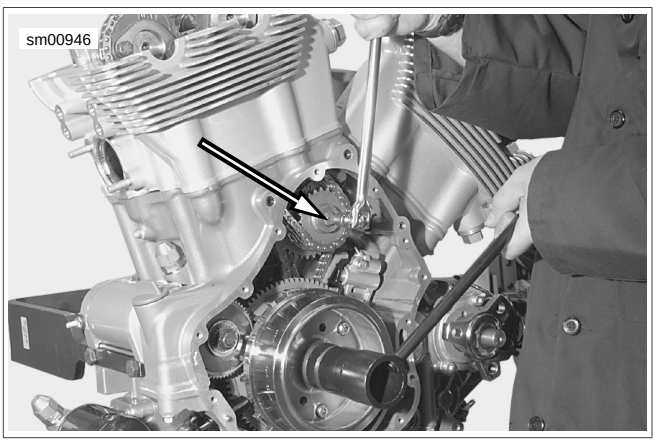



**Figure 3-16. Triple Sprocket Fastener**

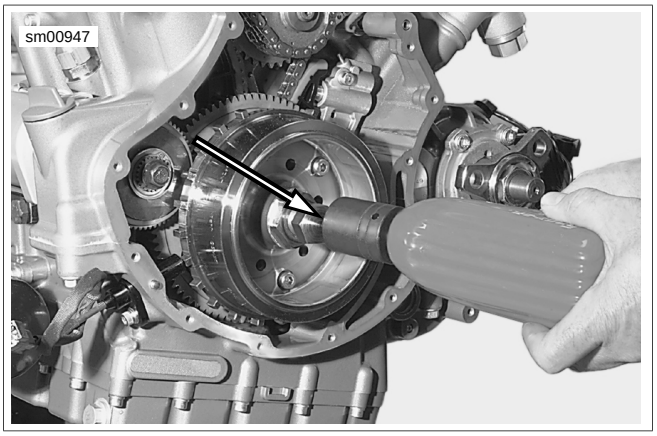



**Figure 3-17. Rotor Shell**

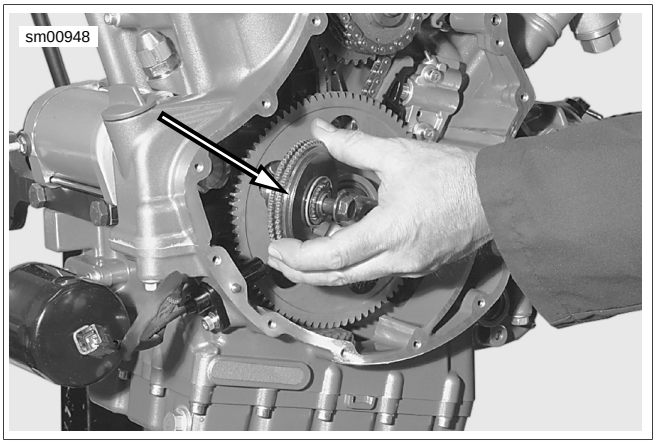



**Figure 3-18. Starter Limiter Gear Assembly**

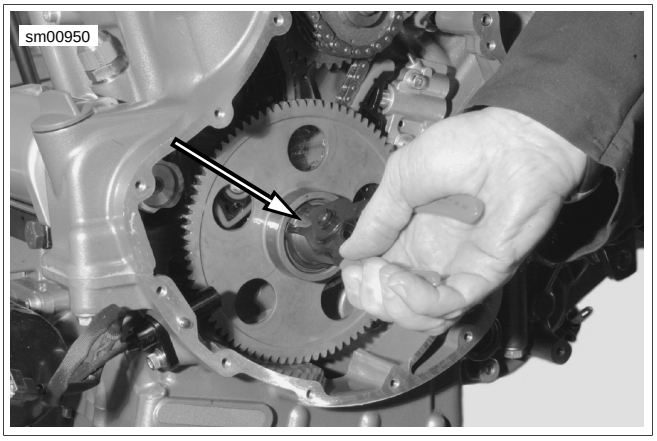



**Figure 3-19. Snap Ring**

18. See Figure 3-20. Slide snap ring, washer, and ball clutch gear with needle roller and cage assembly off of crankshaft.

*NOTES*

- *If the crankshaft rotates slightly, be sure to re-locate front piston TDC.*
- *For the following procedure, the front cylinder cams are pre-loaded.*

19. See Figure 3-21. Install TAPPET COMPRESSSING TOOL (Part No. HD-45491) on front cylinder to aid in disassembly.
    a. Loosen 19 mm nut on tappet compressing tool.
    b. Tools are marked intake and exhaust. Position them accordingly.
    c. Tighten 19 mm nut to compress tappets.
20. See Figure 3-22. Remove secondary cam chain tensioner.

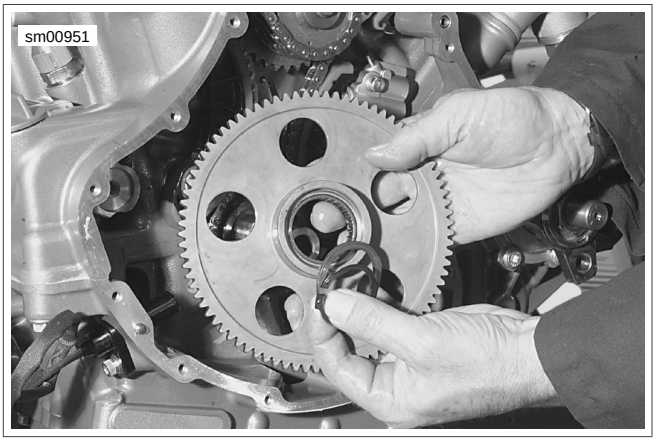



**Figure 3-20. Snap Ring and Ball Clutch Gear**

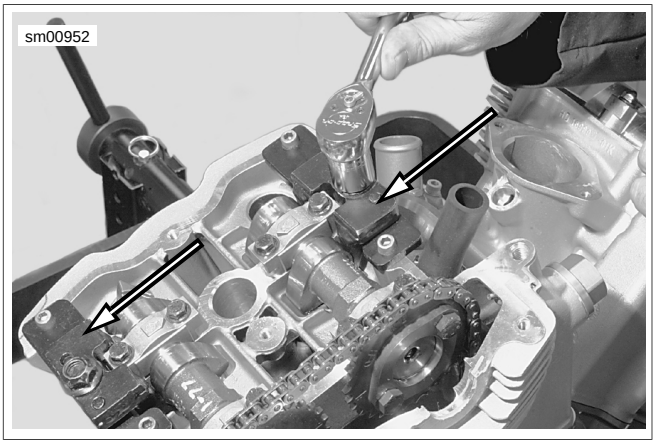



**Figure 3-21. Tappet Compressing Tools (HD-45491) (typical)**

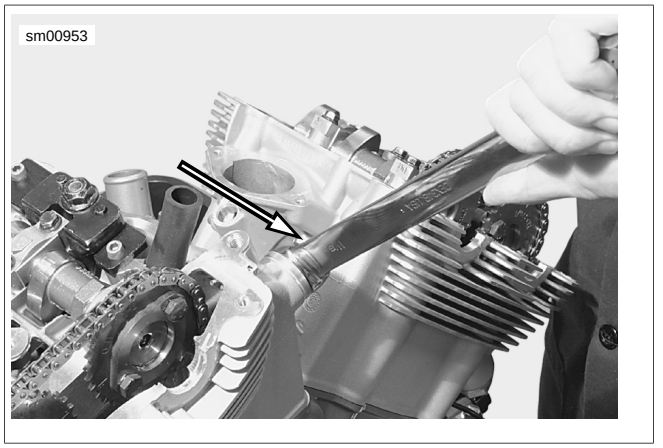
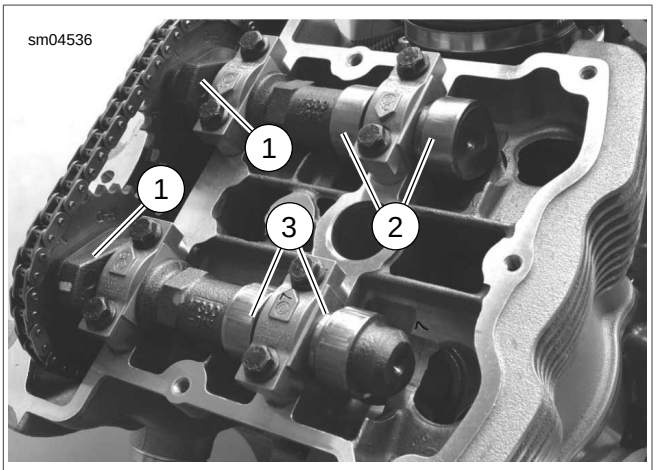



**Figure 3-22. Remove Secondary Cam Chain Tensioner (typical)**




1. **Spacer boss**
2. **Intake cam lobes**
3. **Exhaust cam lobes**

**Figure 3-23. Rear Cylinder Cams**

*NOTES*

- *Mark or tag chains, front and rear, to match the chains to the front intake and exhaust cam or the rear intake and exhaust cam. The chains are installed with the brass links outboard or on the alternator side.*
- *The front cylinder cams are identified by the spacer boss location on the outside of the cam sprockets.*
- *The rear cylinder cams are identified by the spacer boss location on the inside of the cam sprockets. See Figure 3-23.*

*NOTE*

*Do not attempt to remove camshaft caps without first relieving valve spring pressure using tappet compressing tool on front cylinder.*

21. Remove cam bearing caps.
22. See Figure 3-24. Roll chain over cam drive gear. Lift cam and drive gear from head.
23. In this position the rear cams are not preloaded. Remove rear cylinder bearing caps. Disconnect cams from chain.
24. Remove chains.

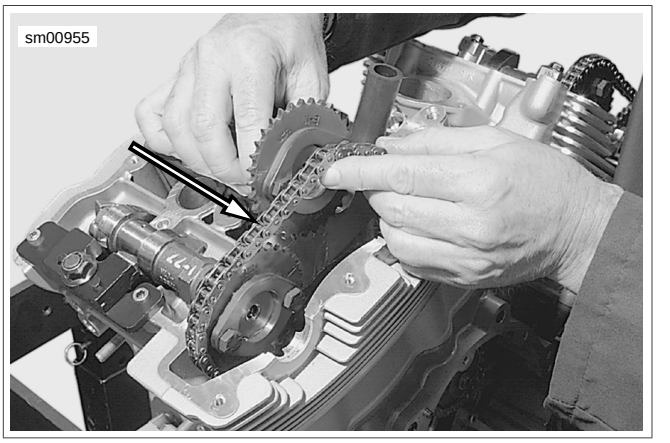



**Figure 3-24. Cam Drive Chain (typical)**

## CAMSHAFT INSPECTION

During a normal engine rebuild, camshafts should be replaced, however if engine is low mileage and apart for another reason, be sure to inspect camshafts for wear. The following details different types of cam manufacturing and wear to be considered during inspection VRSC camshafts.

*NOTE*

*It is not necessary to remove camshafts for this inspection. Camshafts are removed for photo-clarity.*

### Lobe Surface Finish

There are two styles of surface finish found on VRSC camshafts. The first is called camground which can be seen in Figure 3-25. This lobe appears very smooth. The second finish is called micro-stoned which can be seen in Figure 3-26. This lobe will have horizontal finish marks on the lobes from the finishing stone used in the manufacturing process. Both are acceptable finishes on VRSC camshaft lobes.

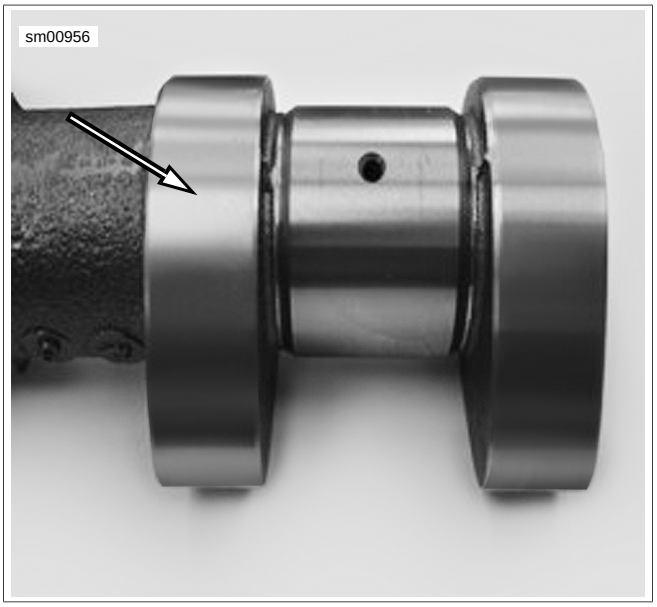



**Figure 3-25. Camground Camshaft Lobes**

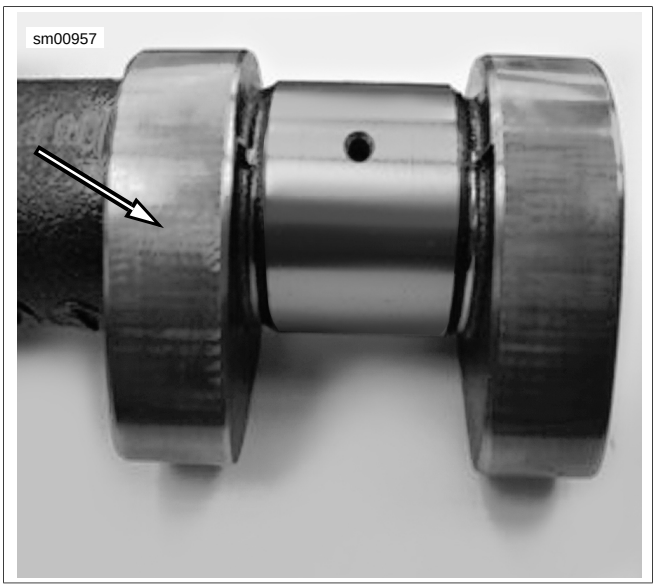



**Figure 3-26. Micro-Stoned Camshaft Lobes**

## Camshaft Spalling

Camshaft spalling can occur on either the heal, toe or ramp of the camshaft lobe. Use the following guidelines to verify if spalling is within specification.

- See Figure 3-27. Camshaft spalling within an acceptable specification on toe of camshaft lobe.
- See Figure 3-28. Camshaft spalling on camshaft heel at an unacceptable level as spalling extends across entire camshaft lobe.

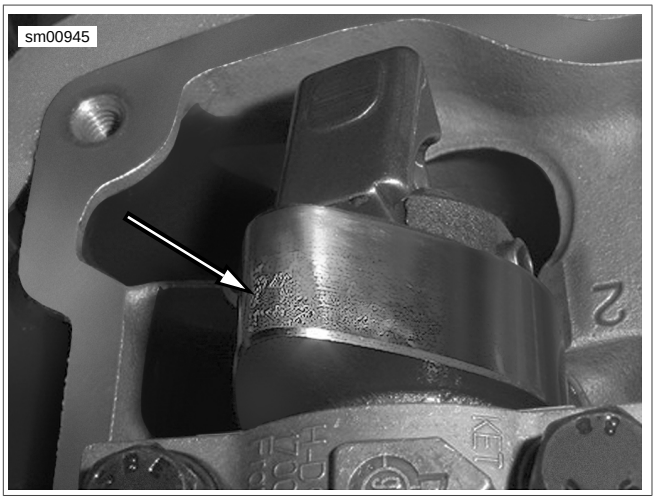



**Figure 3-27. Camshaft Toe Spalling (typical)**

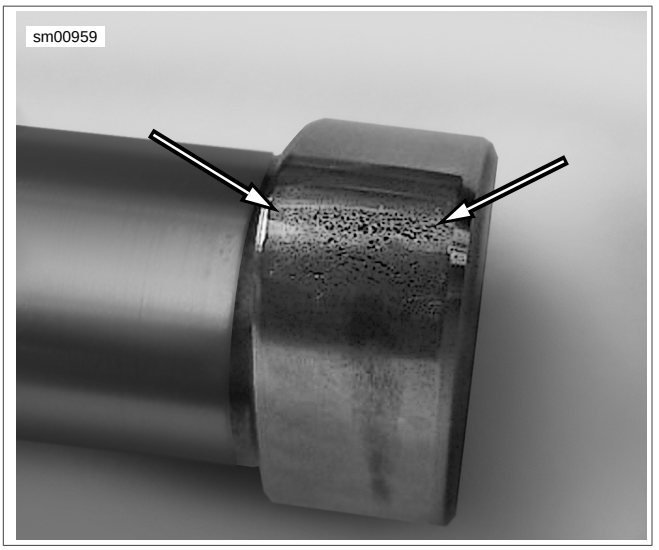



**Figure 3-28. Camshaft Heel Spalling**

*NOTE*

*If camshaft lobe exhibits spalling that extends fully across the width of the camshaft lobe or extends past 15 mm beyond the toe of the camshaft lobe in either direction of camshaft travel, replace camshaft.*

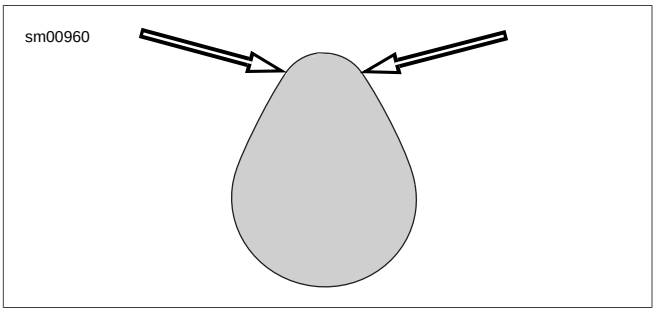



**Figure 3-29. Cam Lobe (typical) showing 15 mm from toe of camshaft lobe on each side of lobe**

## PRIMARY CAM DRIVE REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-43526 | PRIMARY CHAIN TENSIONER RETAINER |

1. Remove water pump fasteners and cover.
2. See Figure 3-30. Remove water pump housing. Using a soft face hammer, GENTLY tap around edge of housing while exerting outward pressure.
3. See Figure 3-31. Retract primary cam chain tensioner and insert PRIMARY CHAIN TENSIONER RETAINER (Part No. HD-43526). Remove primary cam chain tensioner.
4. See Figure 3-32. Remove primary cam chain fixed guide.
5. See Figure 3-33. Remove the triple sprocket fastener.
6. See Figure 3-34. Push triple sprocket/water pump shaft through engine toward the clutch side.
7. Remove triple sprocket and primary cam chain.

*NOTE*

*For installation procedure, proceed to 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation.*

*If doing a complete engine teardown and rebuild procedure, proceed to 3.9 CYLINDER HEAD and follow steps in 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Removal section.*

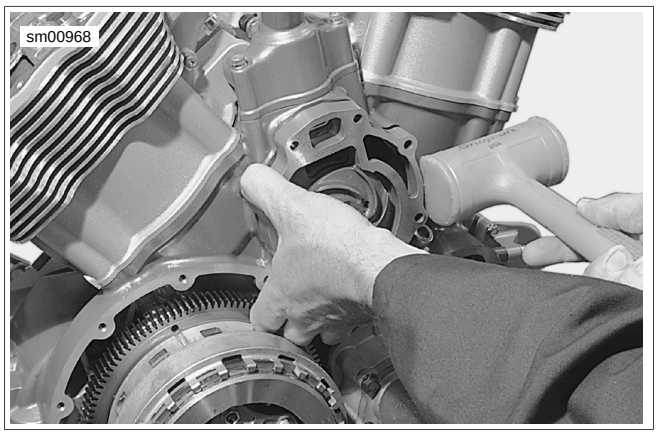



**Figure 3-30. Removing Water Pump Housing**

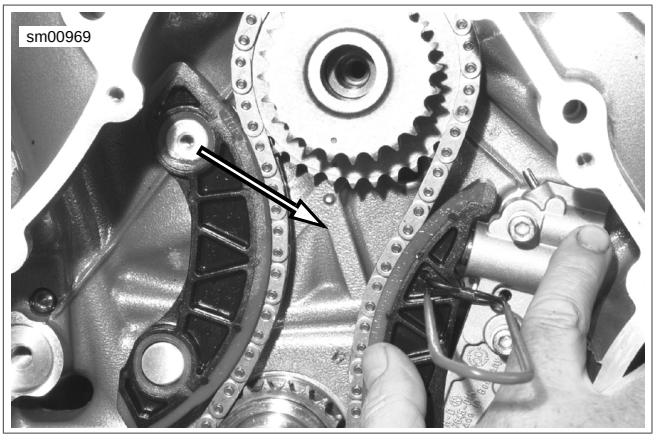



**Figure 3-31. Primary Chain Tensioner Retainer (HD-45326)**

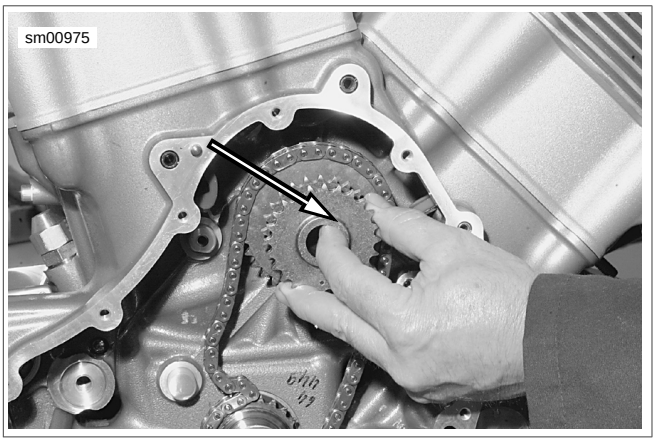



**Figure 3-32. Primary Chain Fixed Guide**

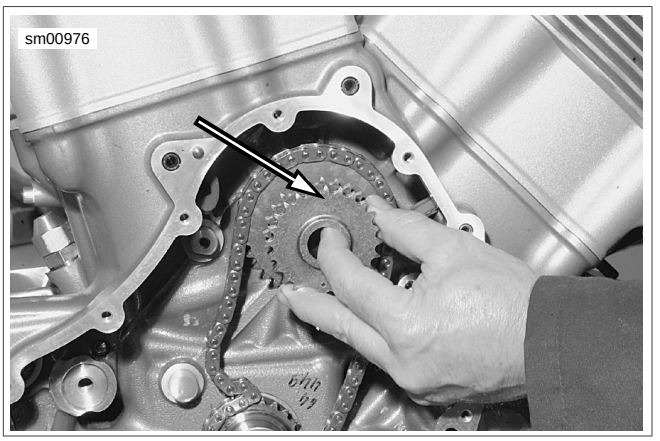



**Figure 3-33. Triple Sprocket Fastener**

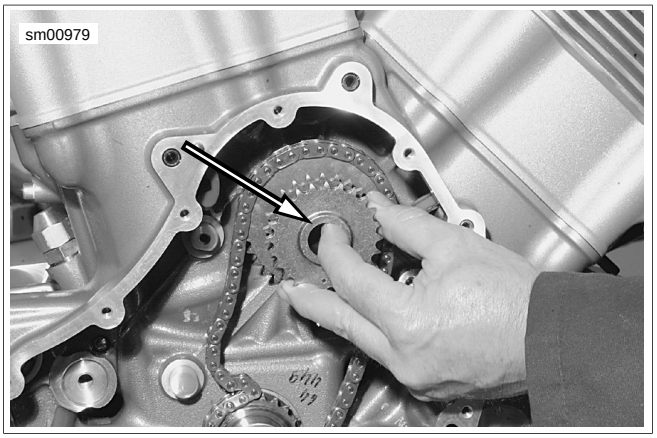



**Figure 3-34. Triple Sprocket/Water Pump Shaft**

## PRIMARY CAM DRIVE INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45306 | CRANKSHAFT LOCKING PIN |
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45326 | PRIMARY CAM CHAIN TENSIONER RETAINER |

1. Rotate the front cylinder piston to TDC. Remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (Part No. HD-45306) The CRANKSHAFT LOCKING PIN should insert flush with engine case.
2. See Figure 3-35. Insert water pump shaft through case until flush with case on cam drive side.
3. See Figure 3-36. Position triple gear on water pump shaft and drive chain on crankshaft drive gear. Squeeze drive chain to simulate the chain position with the chain tensioners in place. Walk chain around crankshaft gear to change position.
4. See Figure 3-37. Install primary chain fixed tensioner. Note the flat in the chain tensioner bore and the flat on the mounting shaft in the case.

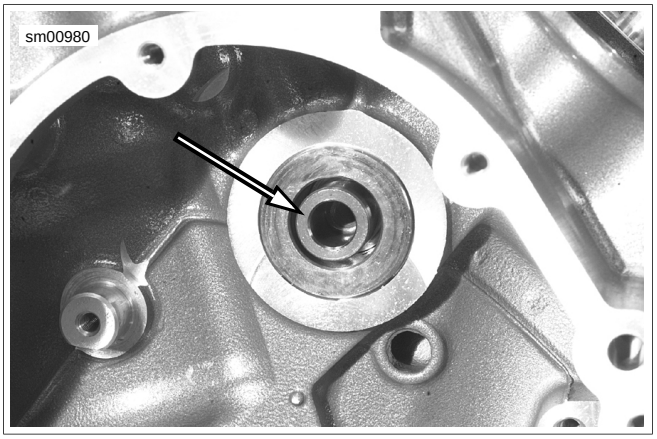



**Figure 3-35. Water Pump Shaft**

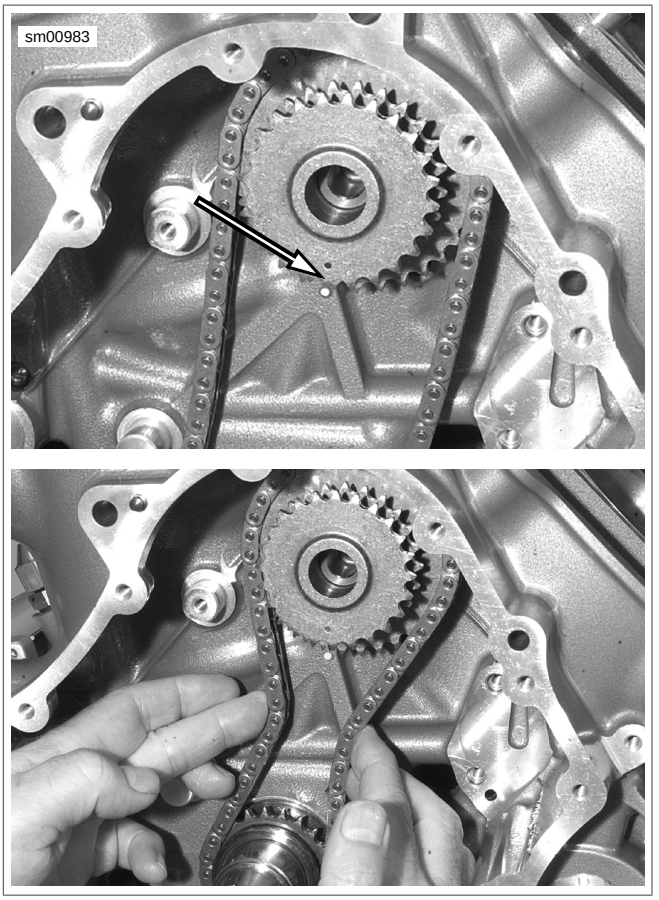



**Figure 3-36. Triple Gear Timing Marks**

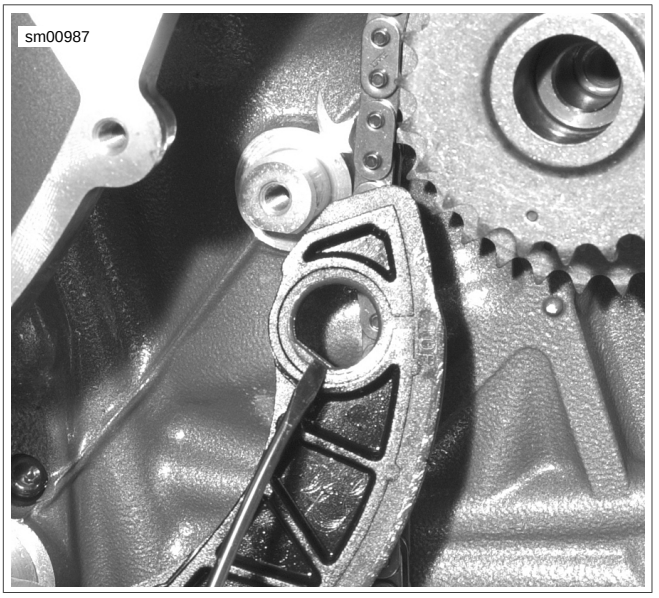



**Figure 3-37. Primary Chain Fixed Tensioner**

5. See Figure 3-38. Use a small screw driver to help guide the chain over the edge of the primary cam chain fixed tensioner.
6. See Figure 3-39. Retract the chain tensioner and install PRIMARY CAM CHAIN TENSIONER RETAINER (Part No. HD-45326) .

7. Confirm the position of the timing marks.
8. See Figure 3-40. Install primary chain hydraulic tensioner fastener. Tighten to 9.7 Nm (86 **in-lbs**) .
9. See Figure 3-41. Install triple sprocket fastener. Tighten to 23 Nm (17 ft-lbs) .
10. See Figure 3-42. Install fastener on primary chain fixed tensioner. Tighten to 9.7 Nm (86 **in-lbs**) .
11. See Figure 3-43. Install needle roller bearing, ball gear, and thrust washer on crankshaft.

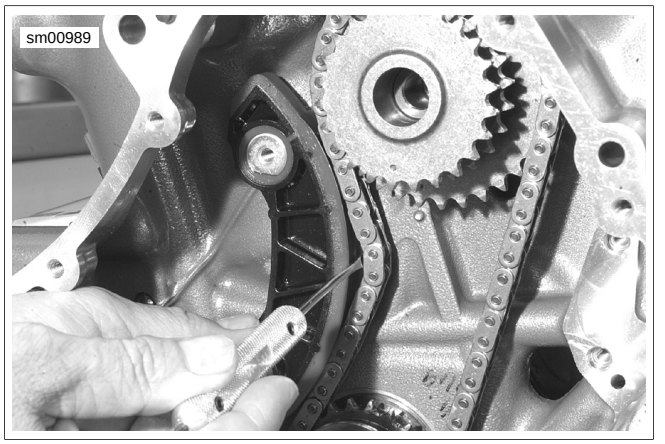



**Figure 3-38. Guide Chain Over Tensioner**

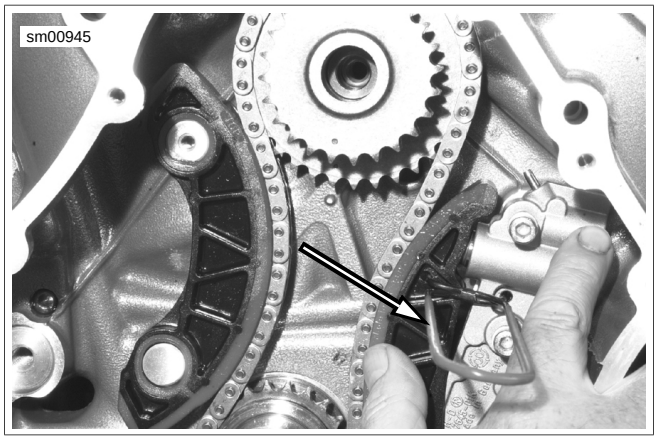



**Figure 3-39. Primary Chain Tensioner Retainer**

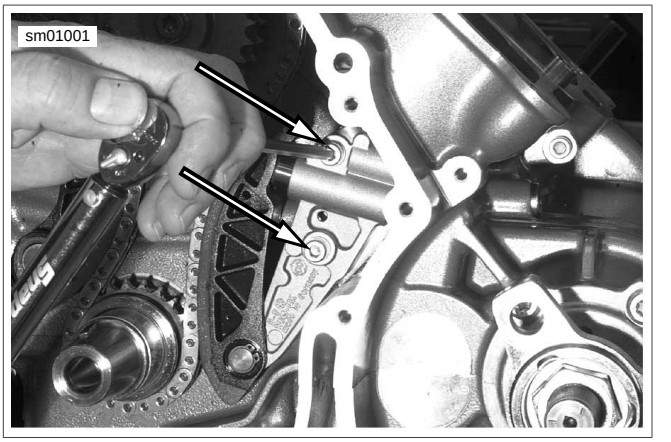



**Figure 3-40. Primary Chain Hydraulic Tensioner**

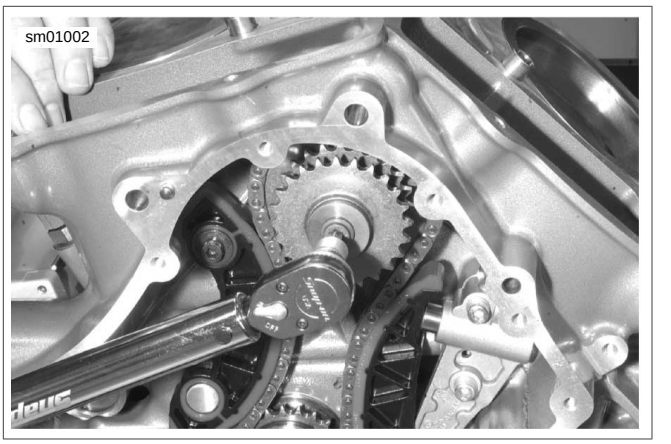



**Figure 3-41. Triple Sprocket**

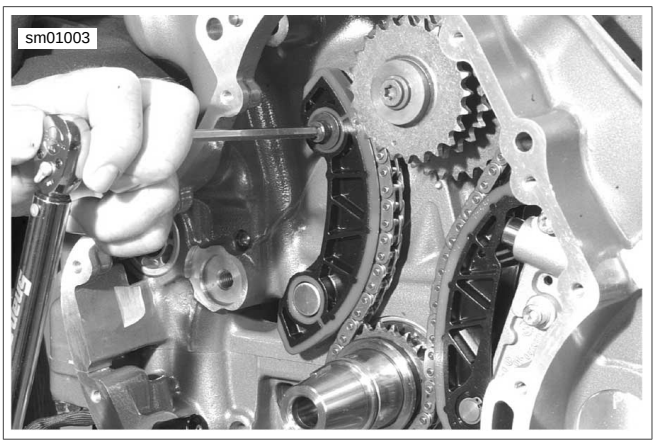



**Figure 3-42. Primary Chain Fixed Tensioner**

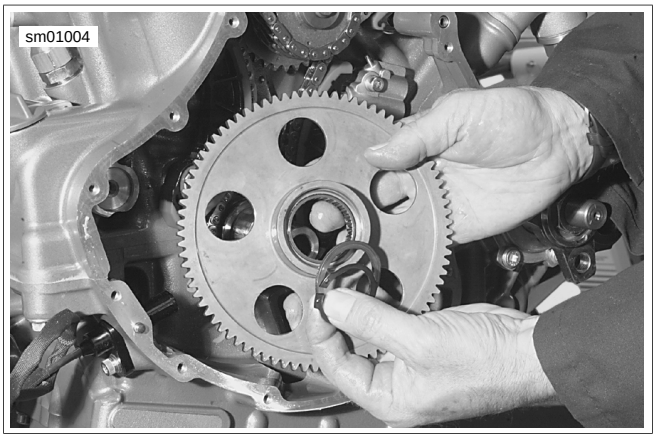



**Figure 3-43. Needle Roller Bearing, Ball Gear, Thrust Washer and Retaining Ring**

12. See Figure 3-44. Snap the retaining ring into place.




**Figure 3-44. Retaining Ring**

13. See Figure 3-45. Install starter limiter gear assembly and starter limiter fastener. Tighten fastener to 46 Nm (34 ft-lbs).

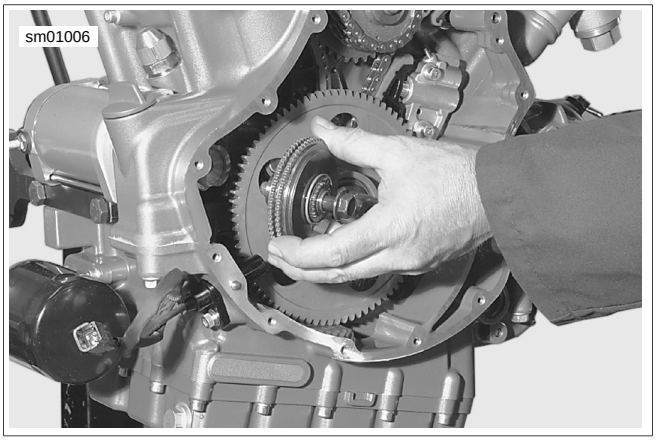



**Figure 3-45. Starter Limiter Gear and Fastener**

14. See Figure 3-46 Install rotor shell with the integral ball clutch.

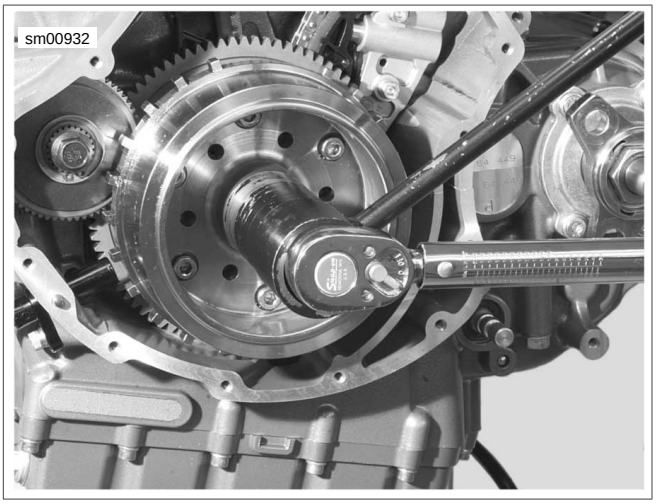



**Figure 3-46. Install Rotor Shell**

15. See Figure 3-41. Hold the 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) and tighten rotor nut.
    a. Tighten to 82 Nm (60 ft-lbs).
    b. Loosen one full turn.
    c. Tighten to 180 Nm (132 ft-lbs).

*NOTE*

*Check to be certain woodruff key has not slipped out of keyway during assembly.*

*For engine rebuild procedure, proceed to 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing to continue engine rebuild.*

## INSTALLATION OF CAMS, TIMING CHAINS AND CAMSHAFT TIMING

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45306 | CRANKSHAFT LOCKING PIN |
| HD-45306 | CRANKSHAFT LOCKING PIN |
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45316 | CRANKSHAFT ASSEMBLY RETAINER |
| HD-45340 | GASKET ALIGNMENT TOOL |
| HD-45491 | TAPPET COMPRESSING TOOL |
| HD-45653 | TDC POSITIONING TOOL |
| HD-45653 | TDC POSITIONING TOOL |

1. See Figure 3-47. Install TDC POSITIONING TOOL (Part No. HD-45653) in front cylinder spark plug hole.

*NOTES*

- *Never insert a foreign object, such as a screwdriver, in the spark plug hole. Engine damage can result.*
- *If camshafts have been replaced, be sure to tighten camshaft sprocket fasteners to 23 Nm (17 ft lbs).*

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

2. Using CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) rotate the engine counterclockwise (direction of operation) to locate front piston TDC.
3. When the TDC reference tool is fully extended, remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (Part No. HD-45306).
4. See Figure 3-48. The CRANKSHAFT LOCKING PIN should insert flush with engine case. It may be necessary to gently rock the crankshaft using the CRANKSHAFT ROTATING WRENCH to lock engine at exact TDC.
5. If removed, record shim thickness for reference and install all eight shims in their original location. Use a magnet to position the shim and push into place with finger.
6. Install tappets in their original locations.

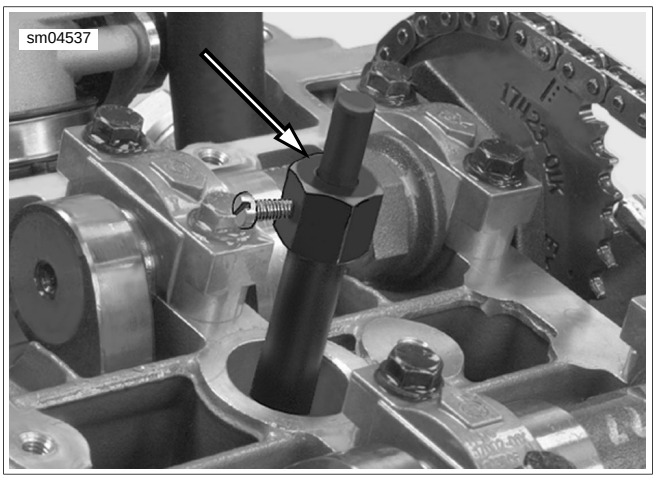



**Figure 3-47. Top Dead Center Positioning Tool**




**Figure 3-48. Crankshaft Locking Pin (HD-45306)**

*NOTES*

- *See Figure 3-49. Match front cam chain to front cylinder cams and rear cylinder chain to rear cylinder cams by marks or tags placed during disassembly. The chains are installed with the brass links outboard or on the alternator side. See 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING.*
- *The front cylinder cams are identified by the spacer boss location on the outside of the cam sprockets. See Figure 3-50.*
- *The rear cylinder cams are identified by the spacer boss location on the inside of the cam sprockets. See Figure 3-51.*

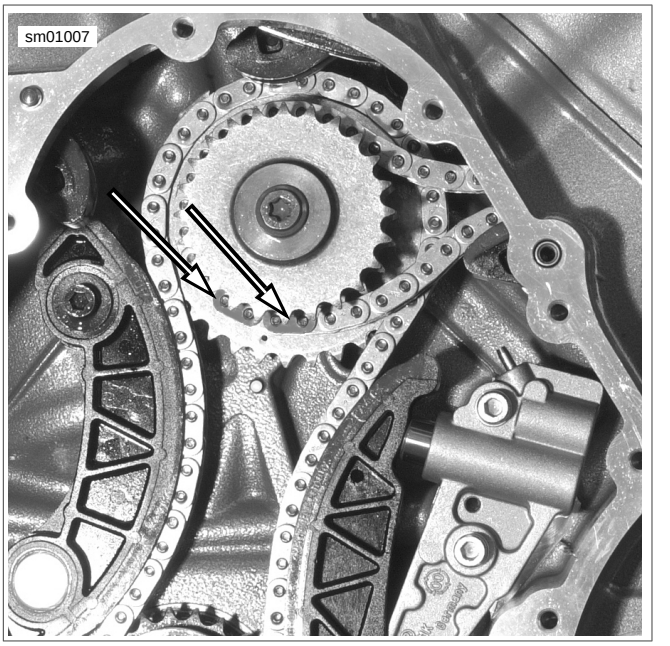



**Figure 3-49. Copper Timing Links**

*NOTES*

- *If cam caps are removed, install and finger tighten before applying torque.*
- *Do not attempt to install camshaft caps without first relieving valve spring pressure using tappet compressing tool on front cylinder. Failure to follow this procedure will result in damage to cylinder head.*

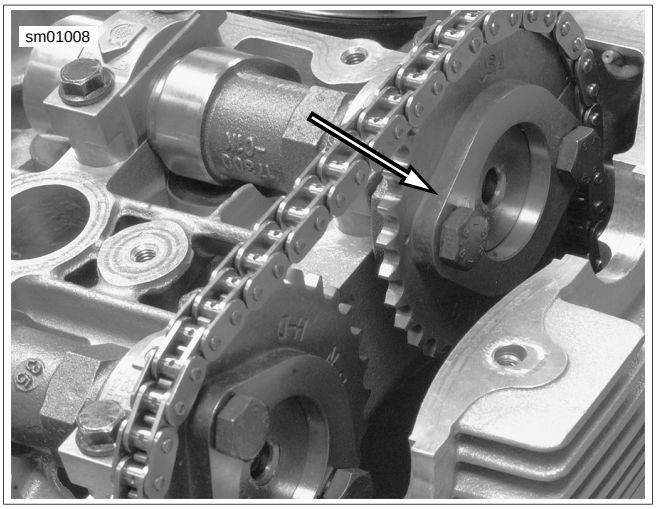



**Figure 3-50. Spacer Boss on Outside (front cylinder cam sprocket)**

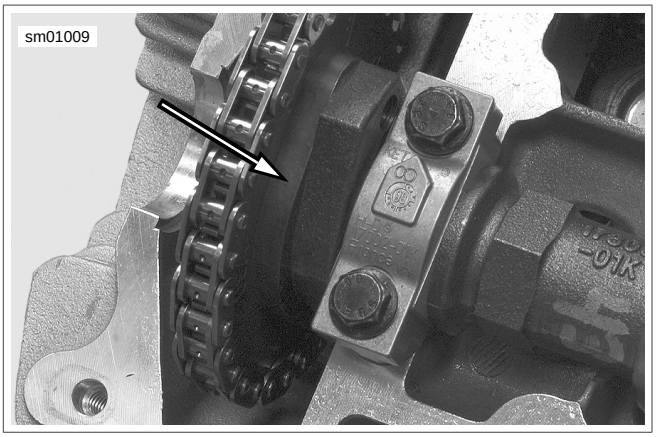
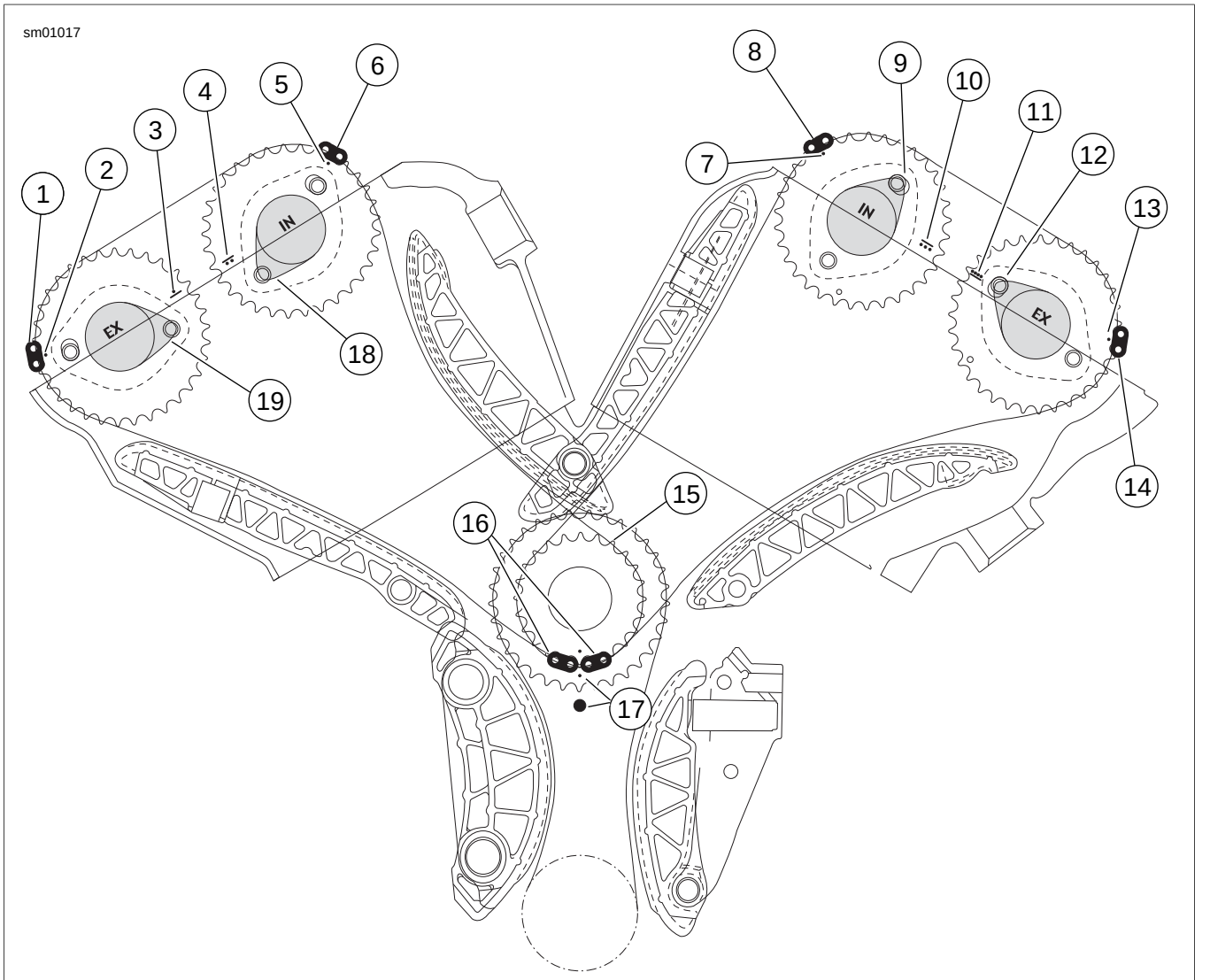



**Figure 3-51. Spacer Boss on Inside (rear cylinder cam sprocket)**




1. **Front exhaust chain copper link**
2. **Front exhaust EX timing dot**
3. **Front exhaust alignment mark (single dot and line)**
4. **Front intake alignment mark (two dots and line)**
5. **Front intake IN timing dot**
6. **Front intake copper link**
7. **Rear intake IN timing dot**
8. **Rear intake copper link**
9. **Rear intake cam lobe position**
10. **Rear intake alignment mark (three dots and line)**
11. **Rear exhaust alignment mark (four dots and line)**
12. **Rear exhaust cam lobe position**
13. **Rear exhaust EX timing dot**
14. **Rear exhaust chain copper link**
15. **Triple sprocket**
16. **Twin cam drive chain copper links**
17. **Triple sprocket to crankcases alignment marks**
18. **Front intake cam lobe position**
19. **Front exhaust cam lobe position**

**Figure 3-52. Cam Drive Timing Marks (secondary cam chain tensioners are not shown)**

*NOTES*

- *Crankshaft must be at front cylinder TDC with CRANKSHAFT LOCKING PIN in place.*
- *Even though cam timing is correct, the copper links may not appear in the positions illustrated. The copper links are used only to aid in the installation of cam chains.*

7. See Figure 3-49. Insert rear cylinder cam drive chain down from the rear head. Wrap chain around middle row of triple sprocket teeth with the copper chain links straddling the triple gear timing marks.

8. See Figure 3-53. Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.




**Figure 3-53. Lubricate Cam**

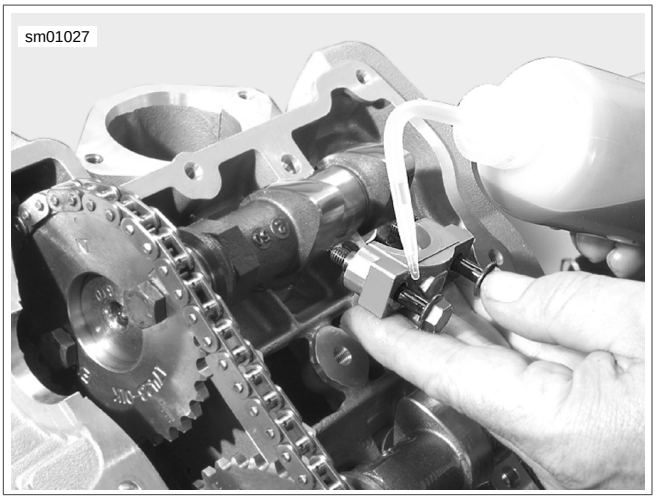



**Figure 3-54. Lubricate Journal Caps and Fasteners**

9. See Figure 3-52. Insert rear exhaust cam into cylinder head and rotate cam sprocket so single copper link (14) straddles the single dot timing mark labeled as EX (13).
10. Insert rear intake cam into cylinder head and rotate cam sprocket so single copper link (8) straddles the single dot timing mark labeled IN (7).
11. See Figure 3-52. For the rear cylinder, verify that:
    a. The single copper link (8) on the cam drive chain straddle the IN single dot (7) on the intake cam sprocket.
    b. The single copper link (14) on the cam drive chain straddles the EX single dot (13) on the exhaust cam sprocket.
    c. The three dot timing line (10) on the intake cam sprocket is aligned with the four dot timing line (11) on the exhaust cam sprocket.
    d. The rear intake and exhaust cam lobes (9, 12) are positioned as illustrated.
12. See Figure 3-54. Lubricate cam journal caps and fasteners.
13. See Figure 3-55. Cam journal caps are numbered. Install cam journal caps with corresponding number on head, arrow pointing to center of head.
14. Tighten cam journal caps to 9.7 Nm (86 **in-lbs**).
15. See Figure 3-56. Install rear cylinder cam chain tensioner and tighten to 100 Nm (74 ft-lbs).

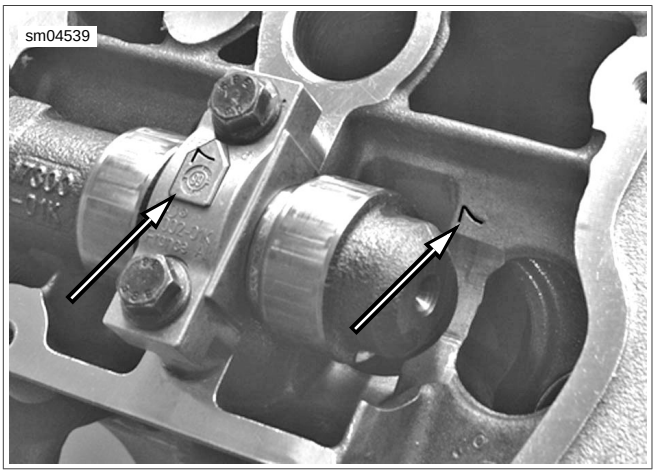



**Figure 3-55. Cam Journal Cap Numbering and Directional Arrow (exhaust cam shown)**

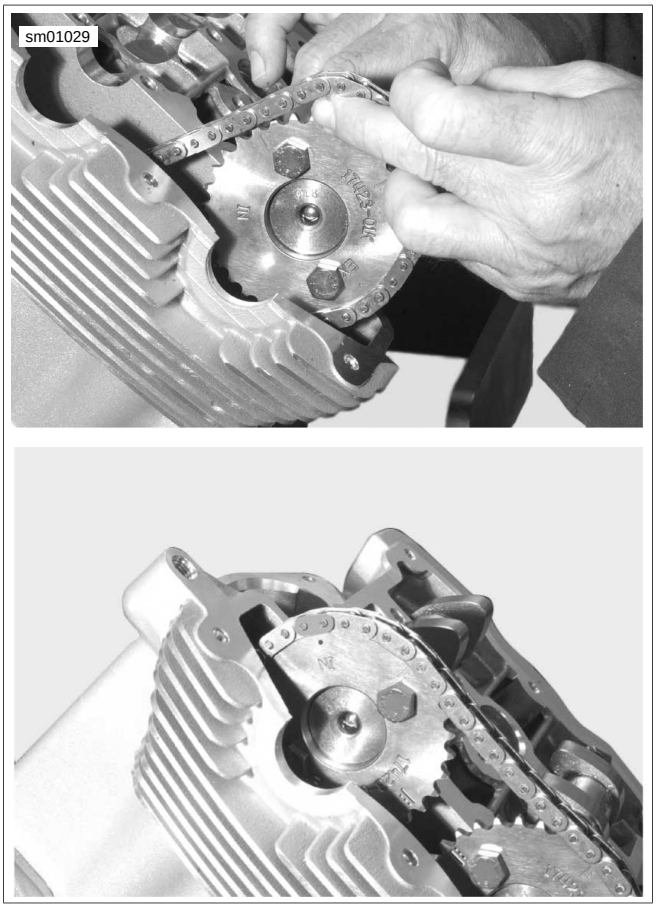



Figure 3-56. Rear Cylinder Cams

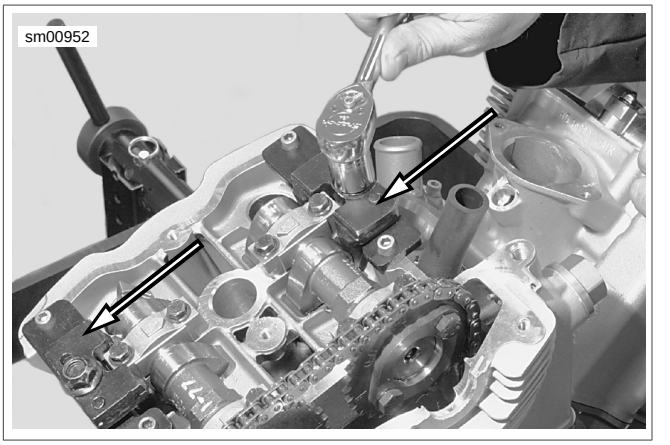



Figure 3-57. Tappet Compressing Tools (HD-45491) (typical)

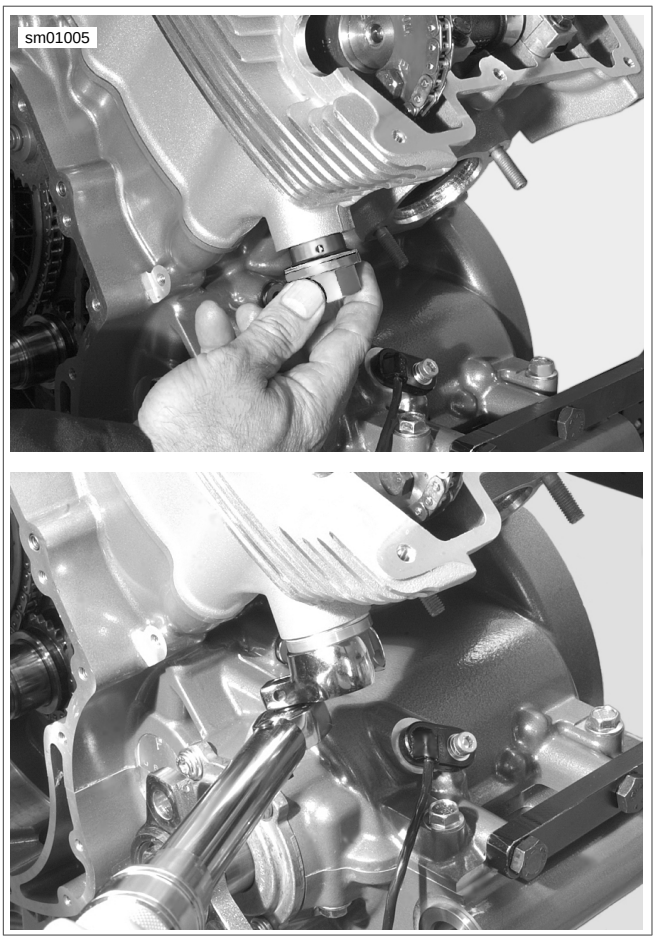



Figure 3-58. Rear Cylinder Cam Chain Tensioner

**CAUTION**

**Never rotate engine with secondary cam chain tensioner removed. Engine damage and loss of correct timing will occur. (00545b)**

16. See Figure 3-57. Install TAPPET COMPRESSING TOOL (Part No. HD-45491) on front cylinder.
    a. Loosen 19 mm nut on tappet compressing tool.
    b. Using the cam cover fasteners install the tappet compressing tool.
17. Tighten 19 mm nut to compress tappets.
18. See Figure 3-60. Insert front cylinder timing cam drive chain down from the front head. Wrap chain around front row of triple sprocket teeth with the copper chain links straddling the triple gear timing marks.
19. Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.
20. See Figure 3-52 Insert front exhaust cam into cylinder head and rotate cam sprocket so single copper link (1) straddles the single dot timing mark (2).

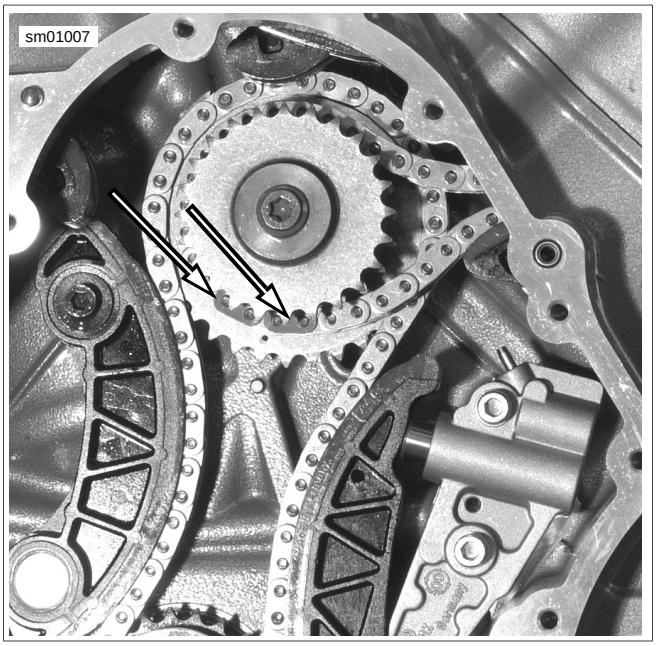



**Figure 3-59. Copper Timing Links**

21. See Figure 3-60. Insert front intake cam into cylinder head and rotate cam sprocket so single copper link (6) straddles the single dot timing mark (5).
22. Install and tighten cam journal caps to 9.7 Nm (86 **in-lbs**).
23. See Figure 3-52. For the front cylinder, verify that:
    a. The single copper link (6) on the cam drive chain straddle the single dot (5) on the intake cam sprocket.
    b. The single copper link (1) on the cam drive chain straddles the single dot (2) on the exhaust cam sprocket.
    c. The two dot timing line (4) on the intake cam sprocket is aligned with the one dot timing line (3) on the exhaust cam sprocket.
    d. The front intake and exhaust cam lobes (18, 19) are positioned as illustrated.

*NOTE*

*Compare lobe positions of each cam shaft to Figure 3-52. If timing marks are correct but camshaft lobes are incorrect, the drive sprocket could be installed incorrectly on the camshaft.*

24. Remove TAPPET COMPRESSING TOOL (Part No. HD-45491).
25. Install front cylinder cam chain tensioner and tighten to 100 Nm (74 ft-lbs).
26. Remove TDC POSITIONING TOOL (Part No. HD-45653) from front cylinder spark plug hole.
27. Remove CRANKSHAFT LOCKING PIN (Part No. HD-45306).
28. Install the engine timing plug and tighten to 23 Nm (17 ft-lbs).
29. Check valve lash and adjust as necessary. See 1.25 VALVE LASH.

*NOTES*

- *If performing a major engine overhaul, conduct a leak down test at this time before mating engine cases to ensure proper seating of piston rings to cylinder wall.*
- *Be sure CRANKSHAFT ASSEMBLY RETAINER (Part No. HD-45316) is installed prior to performing leakdown test.*

30. Install and tighten spark plugs to 23 Nm (17 ft-lbs).

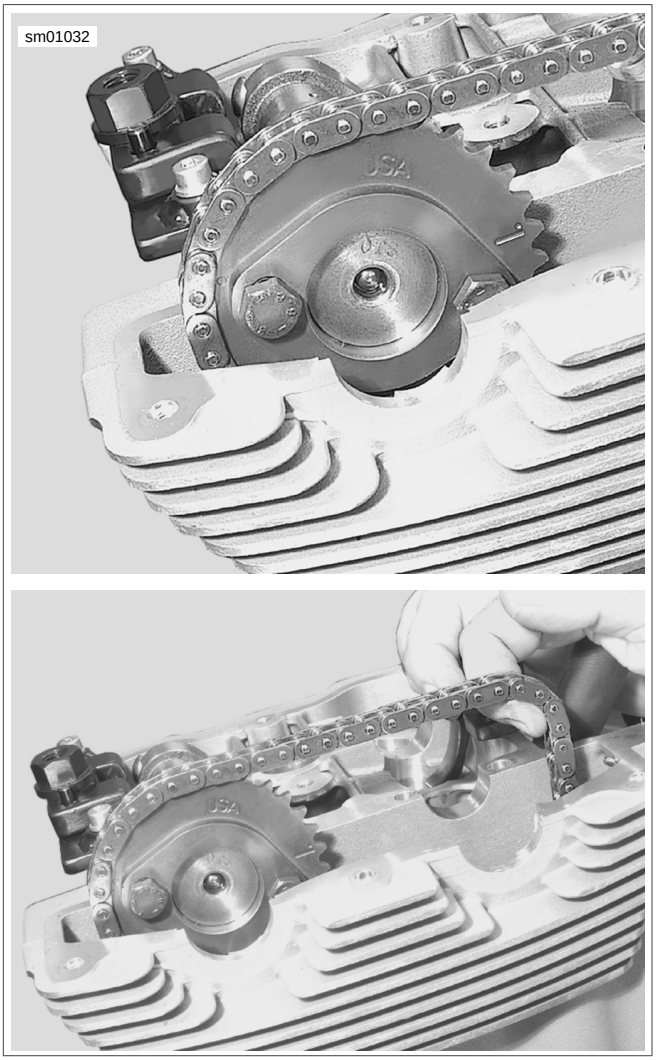



**Figure 3-60. Cam Chain Alignment**

31. Clean cam covers and install **new** gaskets. The rectangular tab fits in the corresponding knockout around the gasket groove in the head.
32. See Figure 3-61. Use cable ties (1) to help retain gasket as shown.
33. Visually check to ensure spark plug hole gasket (2) is in place.

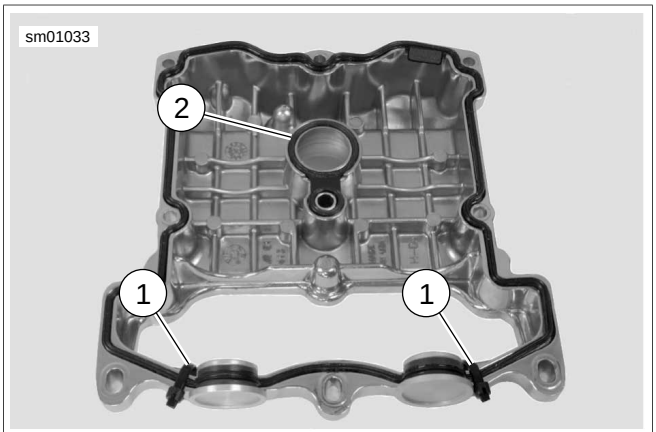
**CAUTION**

**Spark plug hole gasket must be installed with double lip side facing cylinder head to avoid oil leaking into spark plug hole. (00547b)**

*NOTE*

*To aid in assembly, use a small amount of crankcase sealant to ensure positioning of spark plug hole and cam cover gaskets (excluding camshaft half-moons) during assembly.*

34. See Figure 3-63. Apply a 1 mm (0.04 in.) bead of crankcase sealant along gasket recesses in cylinder head not including camshaft half-moon areas. Cam cover gasket **must** stay in place, a small amount of sealer, lightly applied will help.
35. See Figure 3-61. Carefully install cam cover and gasket. Cable straps will allow the cam bore plug to be moved horizontally to clear cam drive gears.
36. Remove cable ties.
37. Place small cam cover in position.
38. Insert GASKET ALIGNMENT TOOL (Part No. HD-45340).
39. See Figure 3-64. Install fasteners in cam cover and tighten to 9.7 Nm (86 **in-lbs**) in sequence.




1. **Cable ties**
2. **Spark plug hole gasket**

**Figure 3-61. Cam Cover Gaskets**




**Figure 3-62. Spark Plug Hole Gasket (double lipped side)**

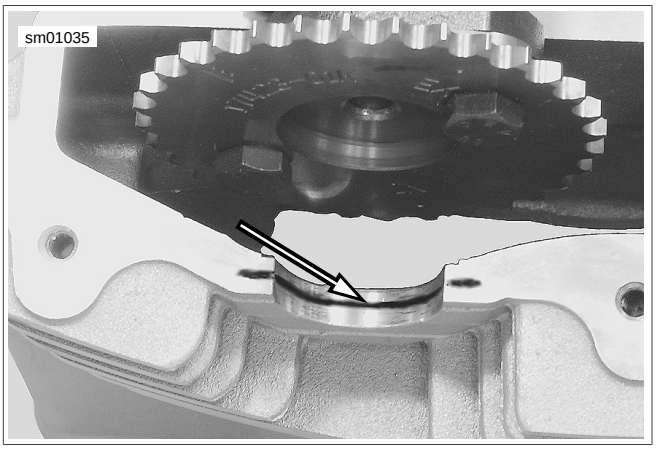



**Figure 3-63. Crankcase Sealant Bead Pattern in Head Recesses**

40. Replace alternator cover. See 8.13 ALTERNATOR.

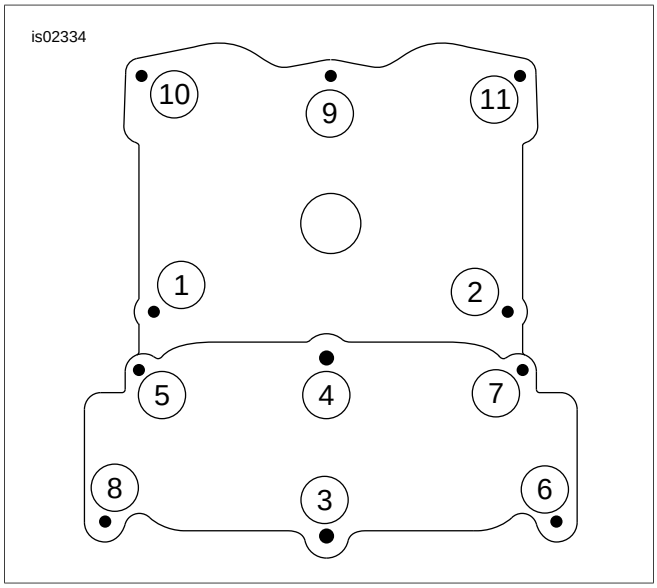



**Figure 3-64. Cam Cover Torque Sequence**

41. Install oil pump. See 3.12 OIL PUMP.
42. Install clutch and clutch cover. See 7.2 CLUTCH.
43. Install water pump. See 6.5 WATER PUMP.

*NOTE*

*For engine rebuild procedure, proceed to 7.3 TRANSMISSION to continue engine rebuild.*

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| 1MFLE140 | SNAP-ON |
| HD-39786 | CYLINDER HEAD HOLDING FIXTURE |
| HD-45312 | CAM CHAIN TENSIONER GUIDE PIN REMOVER/INSTALLER |
| HD-45333 | CYLINDER HEAD HOLDER |
| HD-45491 | TAPPET COMPRESSING TOOL |

*NOTE*

*TAPPET COMPRESSING TOOL (Part No. HD-45491) is in place from the cam drive removal process, remove it before proceeding. Removing the head with valves extended could result in damage.*

1. See Figure 3-65. Remove seven fasteners retaining head.
   a. Completely remove the three 5mm fasteners (1, 2, 3).
   b. The four main headbolts (4, 5, 6, 7) are external TORX E14. Use SNAP-ON (Part No. 1MFLE140) tool to loosen main headbolts in a crisscross pattern until free.
2. Remove the cylinder heads.
3. See Figure 3-66. Use CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786) and CYLINDER HEAD HOLDER (Part No. HD-45333) to secure cylinder head for service.

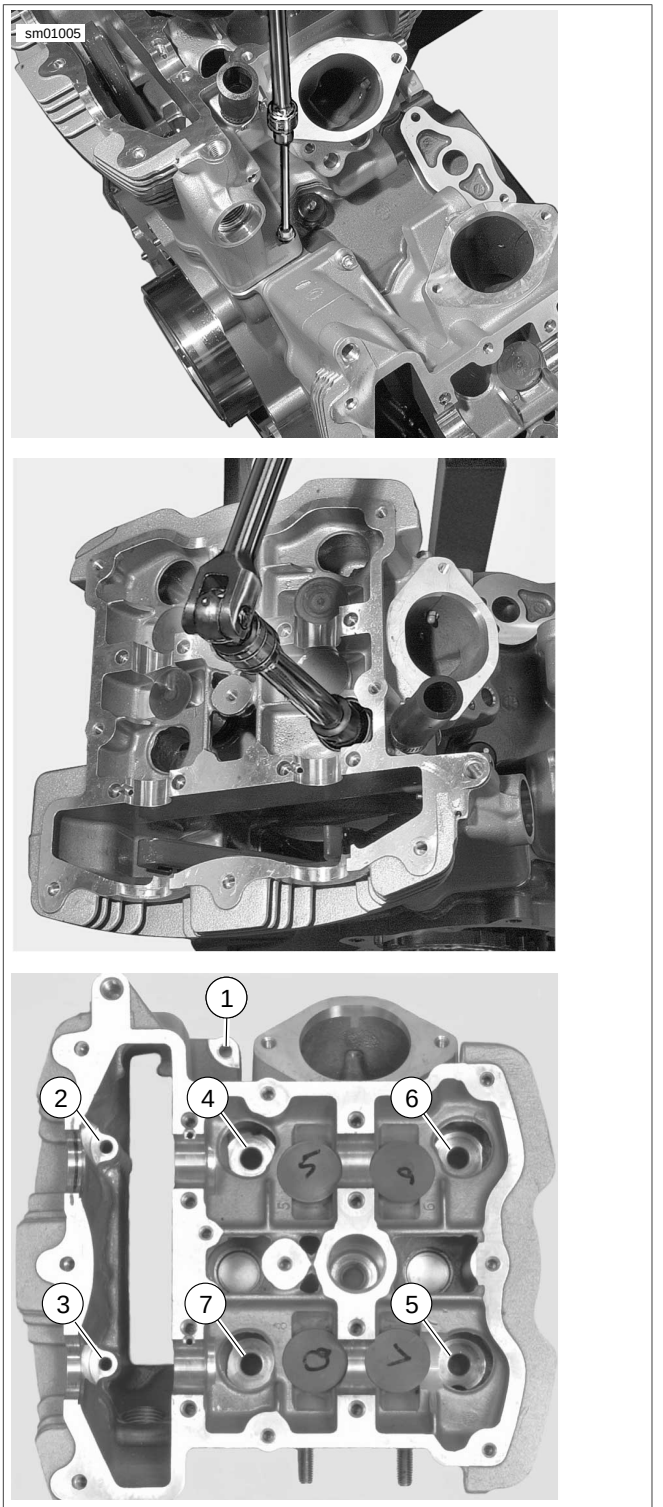



**Figure 3-65. Cylinder Head Fasteners**




**Figure 3-66. Cylinder Head Holder**

4. See Figure 3-67. Use CAM CHAIN TENSIONER GUIDE PIN REMOVER/INSTALLER (Part No. HD-45312) to remove cam chain tensioner pins.

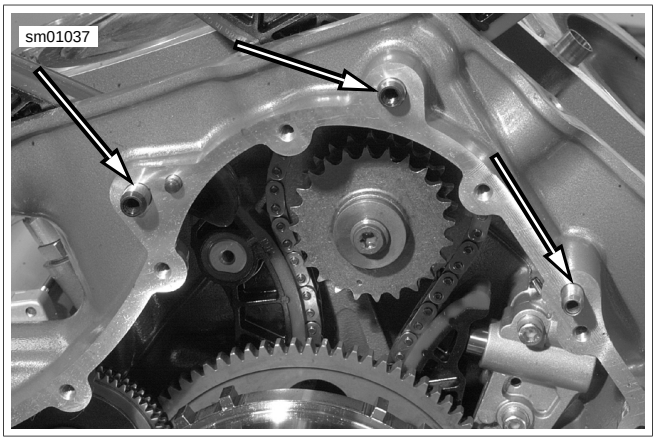



**Figure 3-67. Cam Chain Tensioner Guide Pins**

*NOTE*

*To continue engine disassembly, go to STEP 6 of 3.10 UPPER AND LOWER CRANKCASE SEPARATION.*

## DISASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-34736-B | VALVE SPRING COMPRESSOR |
| HD-34751 | VALVE GUIDE CLEANING BRUSH |
| HD-35758-51 | 6 MM PILOT |
| HD-39782 | CYLINDER HEAD SUPPORT STAND |
| HD-39782-13 | CYLINDER SUPPORT ADAPTER |
| HD-39782-14 | CYLINDER SUPPORT ADAPTER |
| HD-45319 | VALVE GUIDE REAMER |
| HD-45320 | VALVE GUIDE REMOVER/INSTALLER |
| HD-45321 | VALVE GUIDE FLEX HONE |

1. See Figure 3-68. Clean oil film from tappets and use marker to number tappets according to the cast in number at each valve. Remove tappets and shims and keep together for assembly in same position.

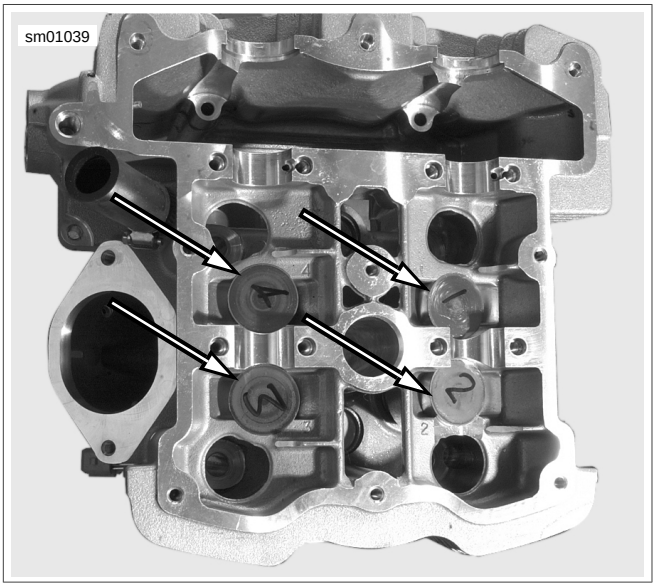



**Figure 3-68. Number Tappets**

2. See Figure 3-69. Install VALVE SPRING COMPRESSOR (Part No. HD-34736-B). Remove valves, springs and keepers. Keep removed parts organized so they will be assembled in same position.

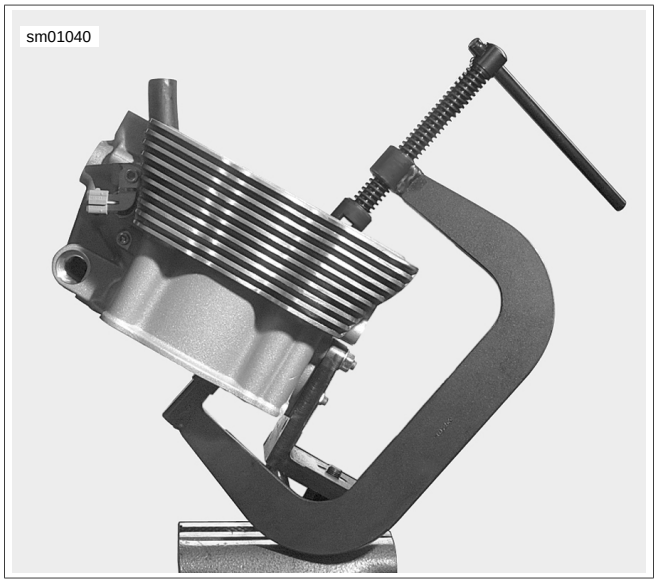



**Figure 3-69. Valve Spring Compressor**

3. See Figure 3-70. Tightly wound coils are always installed to the bottom.




**Figure 3-70. Valve Spring Coils**

4. See Figure 3-71. Check valve spring height and compression rate. Replace if spring height or spring rate is not within specification. See appropriate specification chart in front of engine section.




**Figure 3-71. Valve Spring Compressor**

5. See Figure 3-72. Remove valve guide seal with Snap-on tool number YA8230.

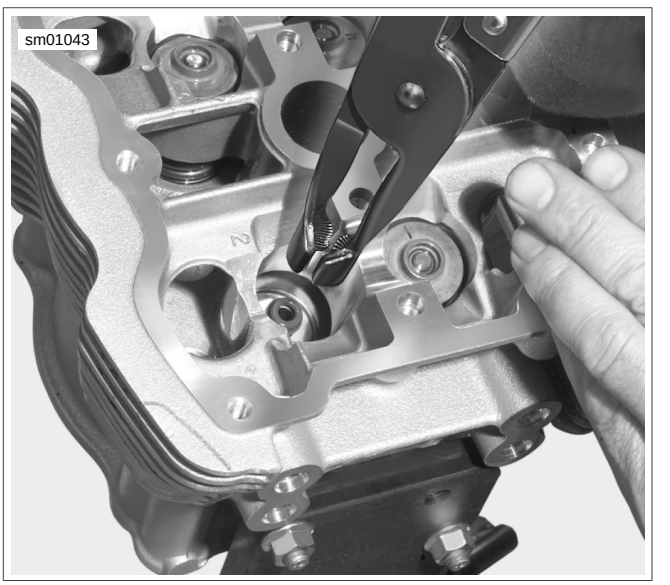



**Figure 3-72. Valve Seal**

6. See Figure 3-73. Measure valve stem diameter and valve guide bore.

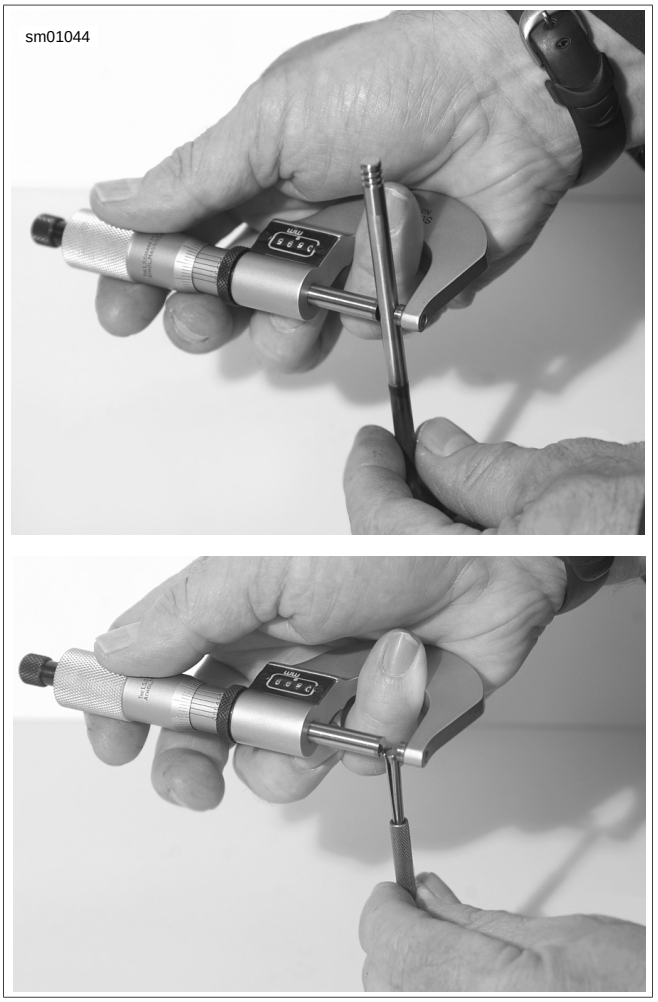



**Figure 3-73. Measure Stem to Guide Clearance**

7. Subtract the valve stem measurement from the valve guide bore measurement to calculate the running clearance.
8. Refer to Table 3-21. Compare the measurements to the table.

**Table 3-21. Valve Guide Running Clearance**

| VALVE GUIDE | | MM | IN |
|---|---|---|---|
| Intake | Min | 0.0285 | 0.0012 |
| | Max | 0.0585 | 0.0023 |
| Exhaust | Min | 0.0385 | 0.0016 |
| | Max | 0.0685 | 0.0026 |

*NOTE*

*Do not remove valve guides within valve guide running clearance. Refer to Table 3-21.*

9. See Figure 3-74. Remove and replace the valve guides that do not meet specifications. Position head for removal of valve guide. Use CYLINDER HEAD SUPPORT STAND (Part No. HD-39782) with CYLINDER SUPPORT ADAPTER (Part No. HD-39782-13) for intake valves and CYLINDER SUPPORT ADAPTER (Part No. HD-39782-14) for exhaust valves.

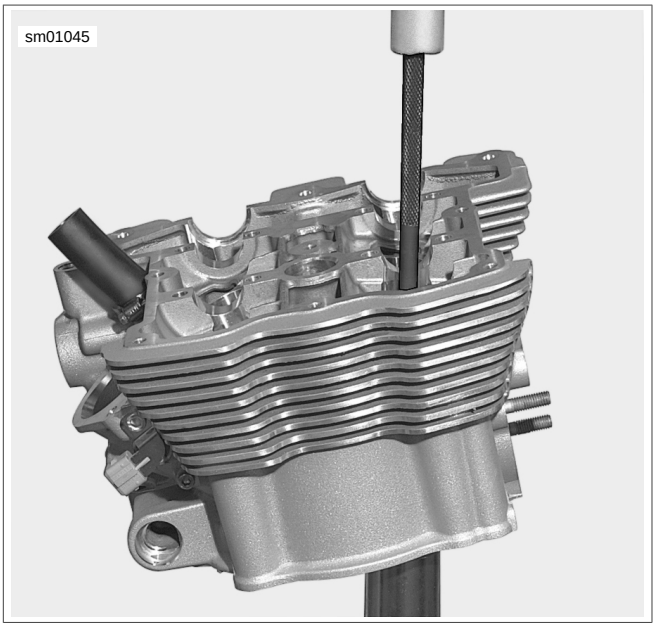



**Figure 3-74. Valve Guide Removal (typical)**

10. See Figure 3-75. Measure cylinder valve guide bore to determine valve guide diameter needed. Select valve guide no larger than 0.051 mm (0.0020 in.) to 0.022 mm (0.00086 in.) over size of cylinder bore.
11. See Figure 3-76. Use VALVE GUIDE REMOVER/INSTALLER (Part No. HD-45320) to install valve guide at correct height.

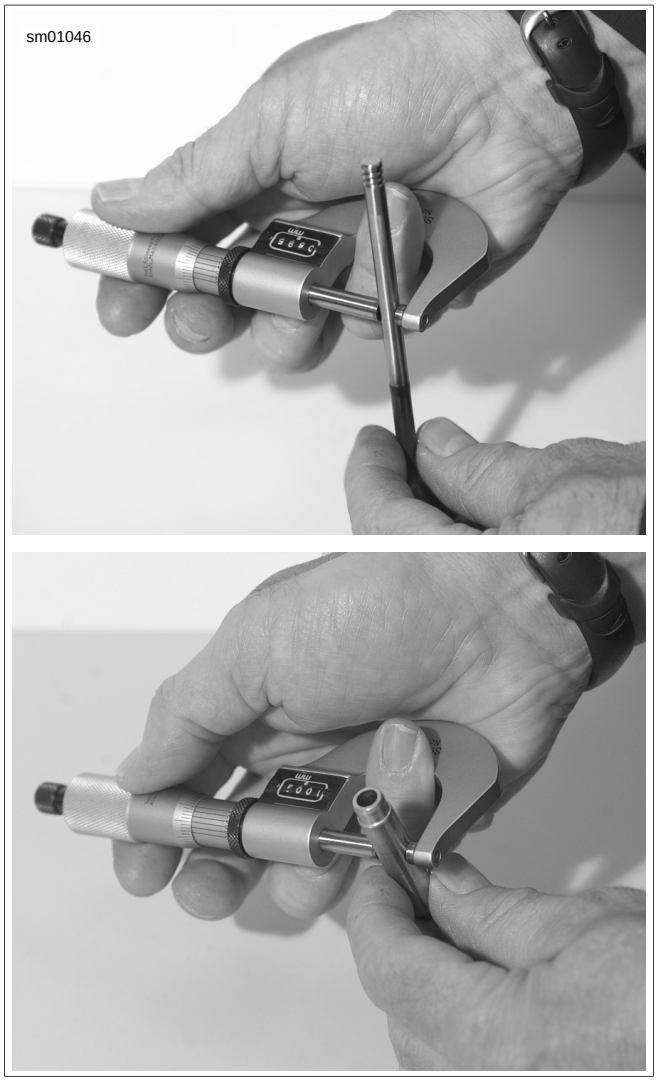



**Figure 3-75. Valve Guide Dimensions**

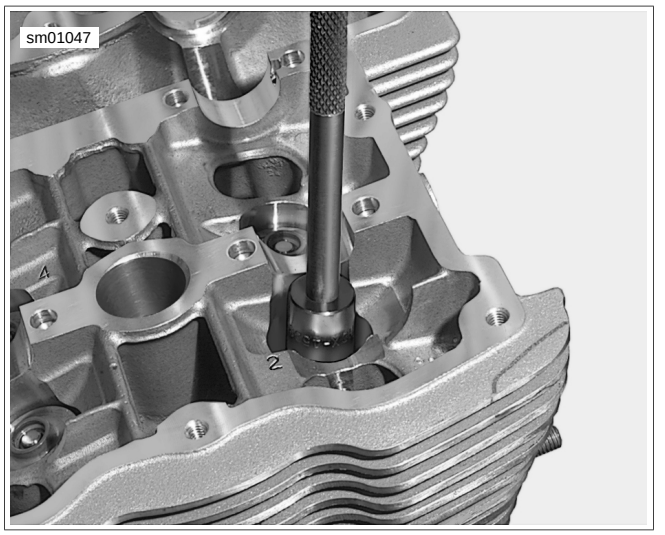



**Figure 3-76. Valve Guide Installation**

12. See Figure 3-77. Use VALVE GUIDE REAMER (Part No. HD-45319) to return installed guide to correct diameter.

13. See Figure 3-78. Use VALVE GUIDE FLEX HONE (Part No. HD-45321) to get the correct surface finish for proper valve stem-to-guide fit and lubrication.

14. See Figure 3-79. Clean valve guide with VALVE GUIDE CLEANING BRUSH (Part No. HD-34751).

15. See Figure 3-80. Verify stem to guide clearance is correct after reaming.

16. Clean valve stem bore and insert 6 MM PILOT (Part No. HD-35758-51) in bore.

*NOTE*

*ALWAYS clean valve stem bore before inserting pilot. Clean bores of all valve guides not replaced as well.*

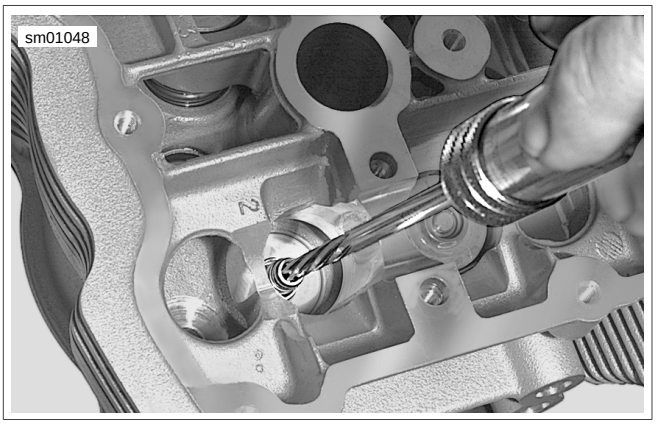



**Figure 3-77. Ream Valve Guide**

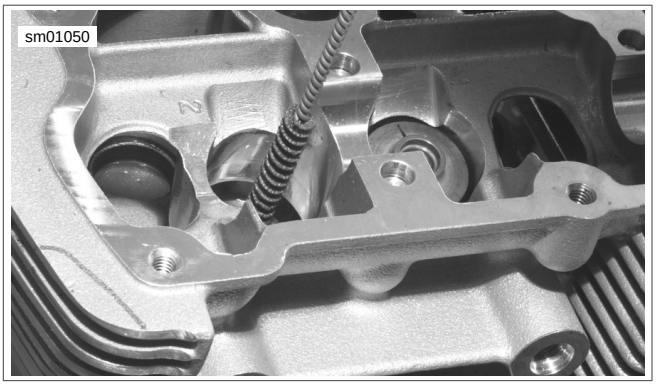



**Figure 3-78. Hone Valve Guide**

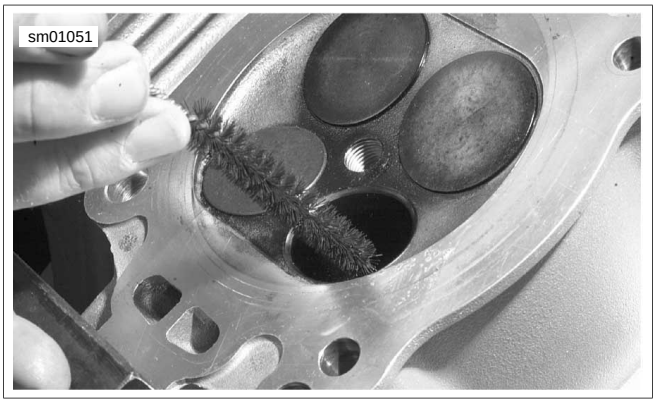



**Figure 3-79. Valve Guide Cleaning Brush (HD-34751)**

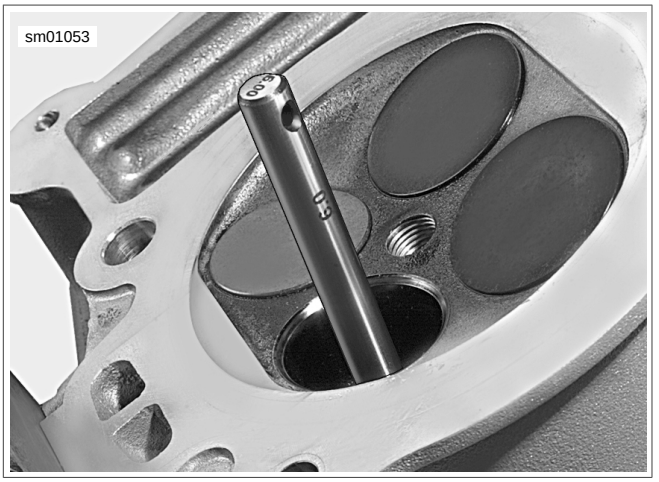



**Figure 3-81. 6 mm Pilot (HD-35758-51)**

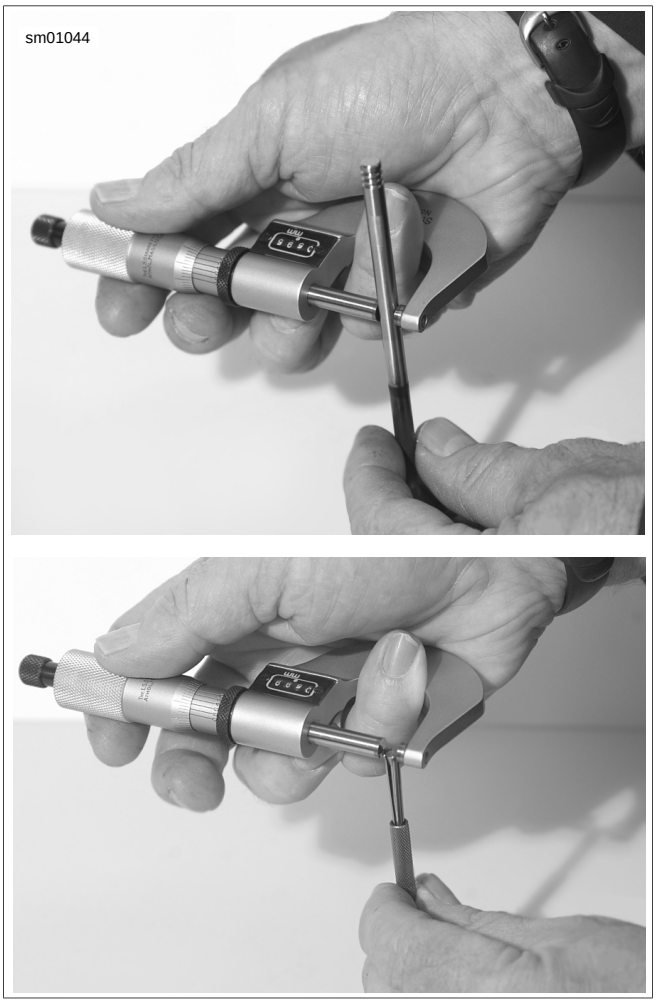
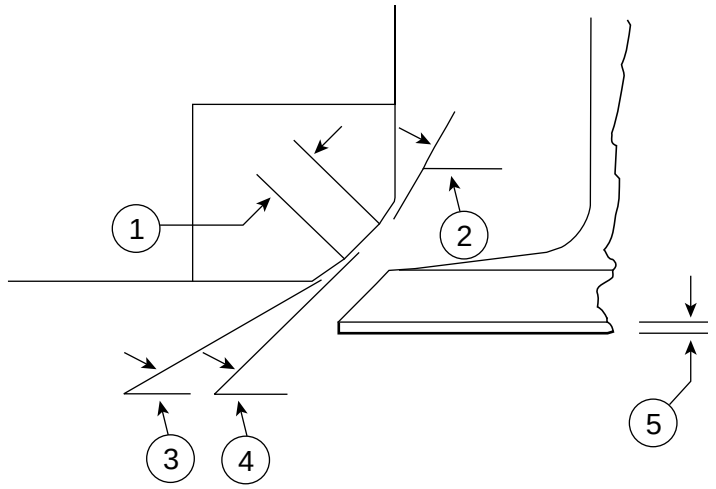



**Figure 3-80. Measure Stem to Guide Clearance**

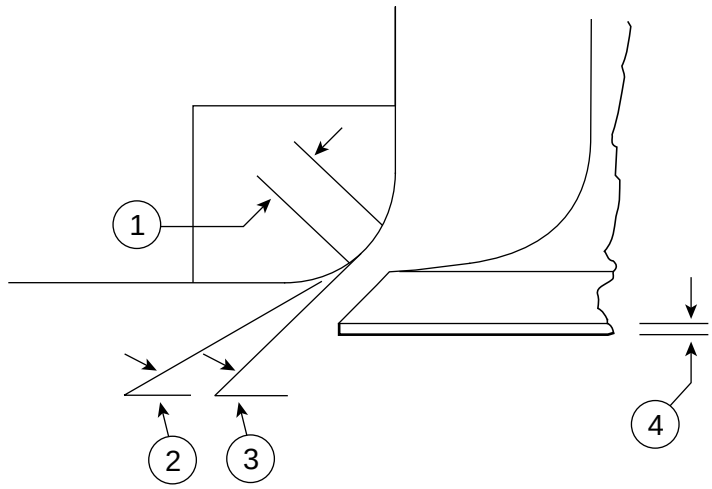
sm01054




1. **Min. 0.750 mm (0.029 in.) Max. 0.860 mm (0.033 in.)**
2. **70°**
3. **30°**
4. **46°**
5. **Min. 0.795 mm (0.0313 in.)**

**Figure 3-82. Intake Valve and Seat**

sm01055




1. **Min. 1.05 mm (0.041 in.) Max. 1.170 mm (0.046 in.)**
2. **30°**
3. **46°**
4. **Min. 0.795 mm (0.0313 in.)**

**Figure 3-83. Exhaust Valve and Seat**

## VALVE SEAT REFACING

| PART NUMBER | TOOL NAME |
|---|---|
| HD-34751 | CLEANING BRUSH |
| HD-35758-50 | NEWAY VALVE SEAT CUTTER SET |
| HD-39786 | CYLINDER HEAD HOLDING FIXTURE |
| HD-45333 | CYLINDER HEAD HOLDER |

*NOTE*

*Verify correct valve stem to valve guide clearance before refacing. Refer to Table 3-22. If **new** guides must be installed, complete that task before refacing valves and seats.*

*NOTE*

*This procedure is not based on the lapping of valves. The end result is an interference fit between the valve of 45° and the valve seat which will be 46°.*

1. See Figure 3-84. Use CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786) and CYLINDER HEAD HOLDER (Part No. HD-45333) to secure cylinder head for service.
2. Clean valve seats and valve faces.
3. Insert the valve stem into the valve guide. Push on the bottom of valve until it contacts the valve seat.
4. Measure valve stem protrusion.
   a. Holding valve against seat, measure distance from top of valve stem to face of spring pocket in cylinder head.
   b. Compare measurement to maximum and minimum for exhaust or intake valve. Refer to Table 3-22.
   c. If valve stem protrusion is longer than the maximum, replace valve seat or cylinder head as necessary.
   d. If valve stem protrusion is less than the minimum, reface the valve seat until the measurement of valve protrusion is within maximum and minimum specifications.

**Table 3-22. Valve Stem Protrusion**

| ITEM | MM | IN |
|---|---|---|
| Intake | Max 44.771 | 1.762 |
| | Min 44.171 | 1.739 |
| Exhaust | Max 43.893 | 1.728 |
| | Min 43.293 | 1.704 |




**Figure 3-84. Cylinder Head Holder**

5. From the NEWAY VALVE SEAT CUTTER SET (Part No. HD-35758-50) use # 622 and cut intake (# 203 for exhaust) valve seat angle to 46°. Do not remove any more metal than is necessary to clean up the seat (that is, to provide a uniform finish and remove pitting).
6. In order to determine the correct location of the 46° valve seat in the head, measure the width of the valve to be used and subtract 1.02 mm (0.040 in.) from that number.
7. Set your dial caliper to the lesser measurement and lock down for quick reference. This is the location of your valve seat.
8. Use a permanent magic marker to highlight the valve seat area that is going to be cut and be sure to highlight all 3 angles. Allow marker to dry before proceeding.

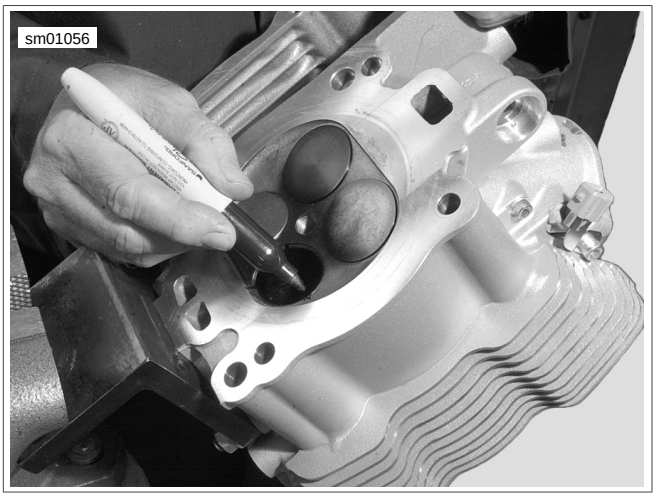



**Figure 3-85. Mark Valve Seat**

*NOTE*

*Always ensure cutter blades and cutter pilot are clean before beginning the cutting process. The correct cleaning brush is supplied with the Neway tool set. Also ensure the inside of the valve guide is clean by using Kent-Moore CLEANING BRUSH (Part No. HD-34751).*

9. Choose the cutter pilot that fits properly into the valve guide hole and securely seat the pilot by pushing down and turning using the installation tool supplied in the tool set.

10. Choose the proper 46° cutter (intake or exhaust) and gently slide the cutter onto the pilot being careful not to drop the cutter onto the seat.

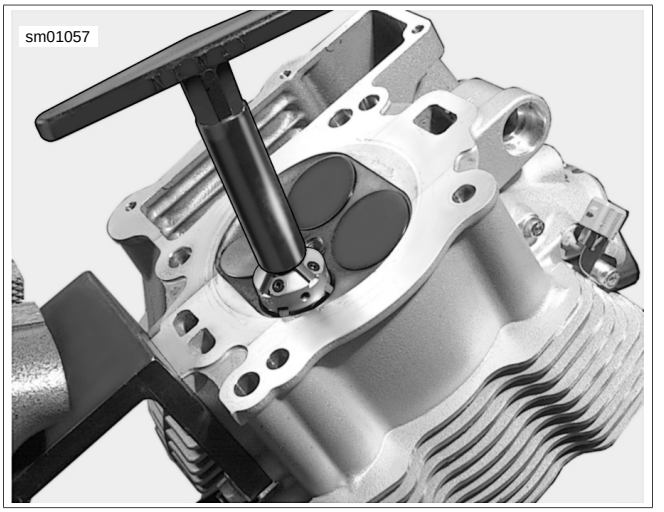



**Figure 3-86. Neway Cutter**

11. While applying a constant and consistent pressure, remove just enough material to show a complete clean-up on the 46° angle.

*NOTES*

- *If the width of the clean-up angle is greater on one side of the seat than the other, the guide may need to be replaced due to improper installation.*
- *After making the 46° cut, if you discover a groove cut completely around the seat this means the blades of the cutter are in alignment and need to be staggered. This is accomplished by loosening all of the blades from the cutter body and moving each blade slightly in its cradle in opposite directions on the cutter. The tool needed to loosen the blades is supplied in the tool set. A permanent magic marker mark every 90° will help in determining where new angles are.*

12. Next, with your dial caliper locked to the predetermined setting, measure the 46° cut at the outer most edge at the widest point of the circle to determine what cut needs to be made next.
    a. If the 46° cut is to high (towards the combustion chamber), use the 31° cutter to lower the valve seat closer to the port.
    b. If the 46° cut is too low, and the width of the valve seat is too wide, use the 70° (intake only) cutter to raise the valve seat or move it away from the port.

*NOTES*

- *Due to using the top measurement of our valve seat as a reference point it will usually be necessary to use the 31° cutter following the initial 46° cut.*
- *Do not cut the bottom angle on the exhaust seat*
- *Always highlight the valve seat with the permanent magic marker in order to ensure the location of the 46° valve seat.*

13. If the location of the valve seat is not correct, repeat steps 6 through 8.

14. When you accomplish a complete clean-up of the 46° angle and the width is at least 0.750 mm (0.029 in.) for intake or 1.050 mm (0.041 in.) for exhaust, proceed to the next step.

15. Select the proper 70° cutter (for intake) and gently slide the cutter down the cutter pilot to the valve seat. The exhaust does not have a bottom angle.

16. See Figure 3-83. Remove just enough material to provide the proper valve seat width.

17. Remove cutter pilot and wash head thoroughly and dry completely.

18. Repeat the process on any valve seat that needs service.

19. Insert valve to be used in the valve guide and bottom on the valve seat. Positioning the cylinder head port upwards and with slight thumb pressure against the valve, completely fill the port with solvent to verify proper seal between the valve and the valve seat.

*NOTE*

*Hold pressure against the valve for a minimum of 10 seconds. If any leakage occurs, examine the valve seat for irregularities or defects and if necessary repeat the above cutting process.*

## HEAD ASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-34736-B | VALVE SPRING COMPRESSOR |
| HD-45322 | VALVE GUIDE SEAL INSTALLER |

1. Thoroughly clean head before beginning assembly.

2. Lubricate valve with Harley-Davidson Motorcycle Oil 20W50 and position in head.

3. See Figure 3-87. Insert lower spring collar.

4. Lubricate valve with Harley-Davidson Motorcycle Oil 20W50 and position in head.

5. See Figure 3-88. Place VALVE GUIDE SEAL INSTALLER (Part No. HD-45322) tapered pin over valve stem and position new seal on the tapered pin. Drive seal into position.

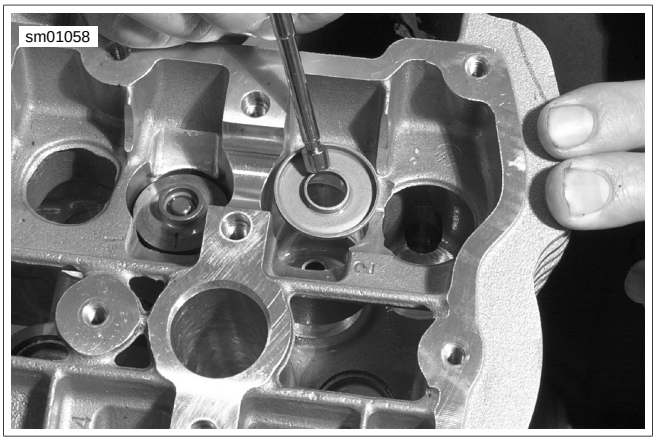



**Figure 3-87. Lower Spring Collar**

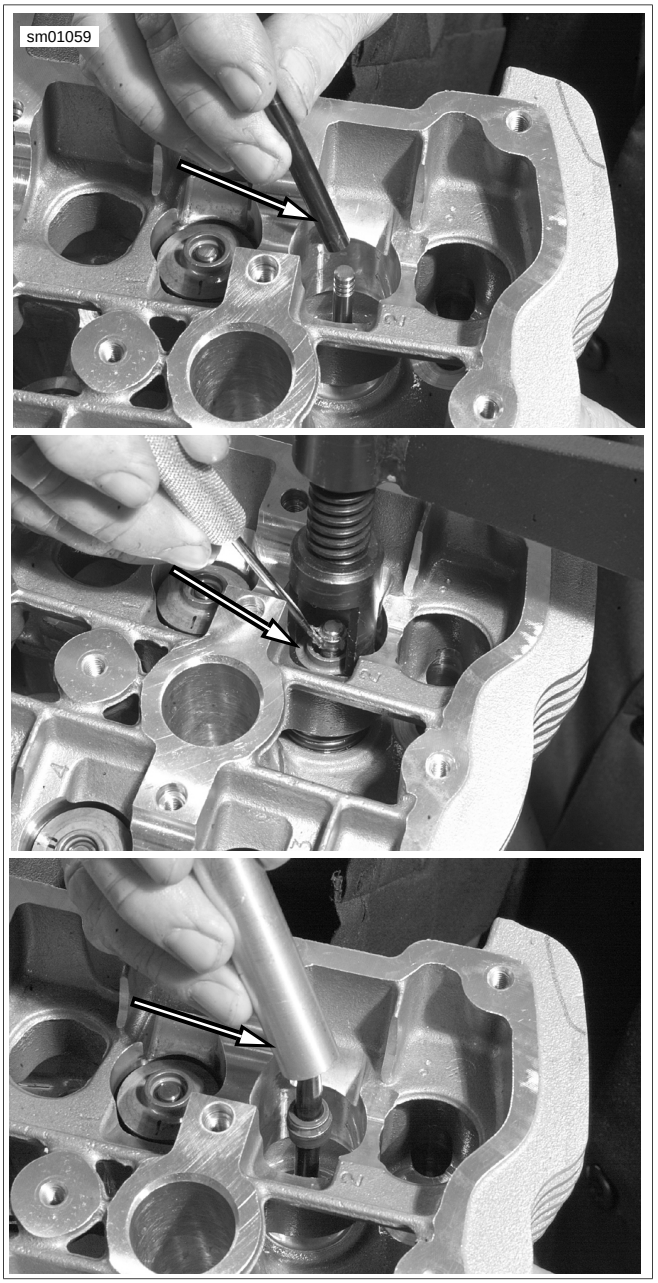



**Figure 3-88. Valve Seal Installation**

6. See Figure 3-89. Install upper spring collar and valve spring and with tightly wound coils to the bottom.
7. See Figure 3-90. Install VALVE SPRING COMPRESSOR (Part No. HD-34736-B) and compress spring to expose valve stem. Apply a light grease around the valve stem to hold keepers in position when relaxing the compressor tool.
8. Install valve keepers and remove compressor tool.
9. Using a micrometer measure and record for reference all valve shims.
10. Install all valve shims in their original location. Use a magnet to position the shim and push into place with finger.
11. Reinstall tappets in their original locations.
12. Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.
13. See Figure 3-91. Install cams and cam journal caps. Tighten cam journal caps to 9.7 Nm (86 **in-lbs**).

*NOTE*

*To accurately check valve lash, cam journal caps MUST be tightened to 9.7 Nm (86 **in-lbs**).*

14. See Figure 3-92. Using a blade type feeler gauge measure valve lash. See 1.25 VALVE LASH, Lash Measurement and D.2 VALVE LASH CALCULATION WORKSHEET 1.
15. Adjust valve lash as required.

*NOTE*

*Valve lash can be measured and adjusted before the heads are installed on engine. However, after head installation, valve lash should be measured and adjusted as required.*




**Figure 3-89. Valve Spring Coils**

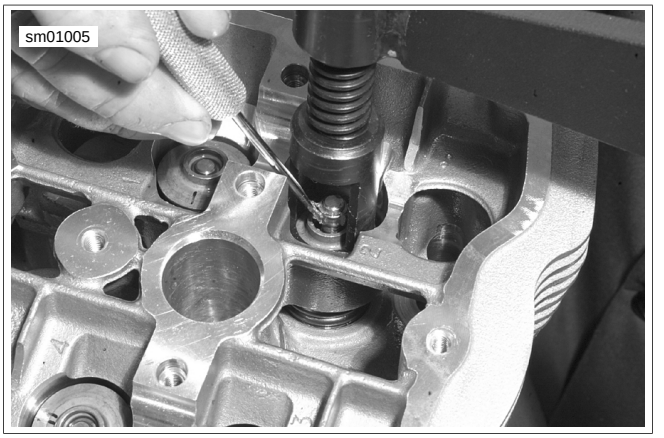



**Figure 3-90. Install Valve Keepers**

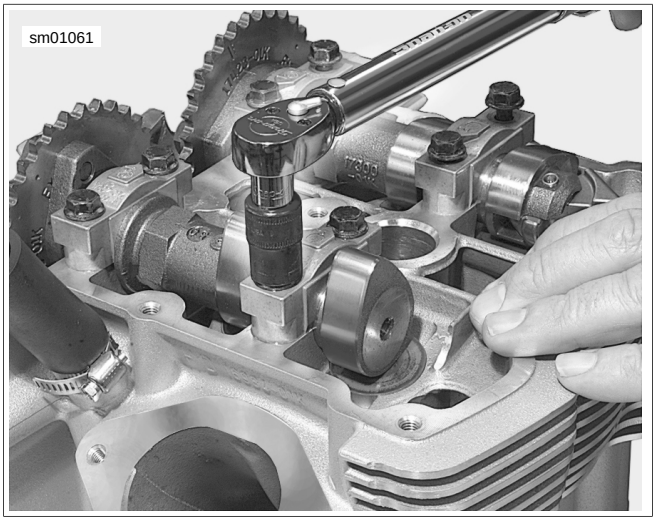



**Figure 3-91. Cam Journal Caps @9.7 Nm (86 in-lbs)**

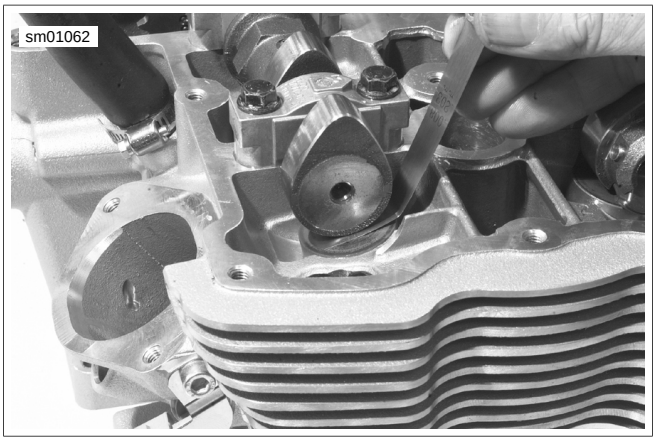



**Figure 3-92. Check Valve Lash (typical)**

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| TA360 | SNAP-ON TORQUE ANGLE GAUGE |

1. Place head gasket on rear cylinder with TOP marking facing up.

*NOTE*

*Note the head gaskets are different for each head and are marked TOP.*

2. See Figure 3-93. Make sure tensioner guide is locked in head as shown.

*NOTE*

*Tensioner guide position is the same in both rear and front cylinder head.*

3. See Figure 3-94. Use Harley-Davidson Motorcycle Oil 20W50 to lubricate the four main head bolts. Lubricate the threads and under the bolt head.

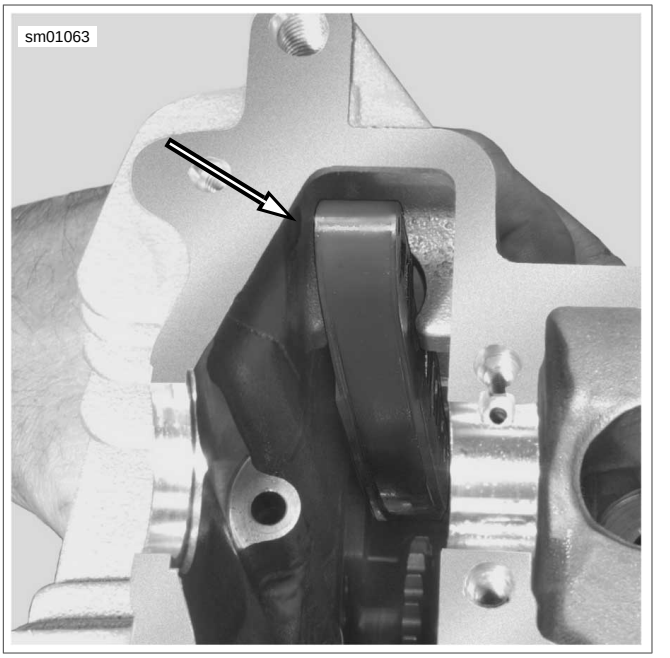



**Figure 3-93. Tensioner Guide Position in Cylinder Head**

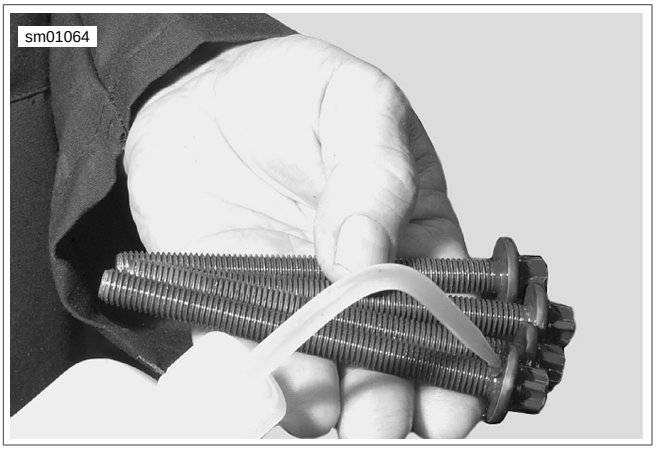



**Figure 3-94. Lubricate Head Bolts**

4. See Figure 3-95. Tighten four main head bolts in sequence.
   a. See Figure 3-96. Tighten bolts to 35 Nm (25.8 ft-lbs).
   b. Loosen each bolt one full turn (360°).
   c. Tighten bolts to 20 Nm (14.8 ft-lbs).
   d. Position the SNAP-ON TORQUE ANGLE GAUGE (Part No. TA360) per instruction sheet and tighten bolt an additional 90°.

*NOTE*

*The notation for this torque sequence is written: 35 Nm - 360°, 20 Nm + 90°.*

5. See Figure 3-97. Install 5 mm head bolts. The two long bolts are installed in positions 6 and 7. The short bolt is installed in position 5.
6. Tighten 5 mm head bolts to 9.7 Nm (86 **in-lbs**) .

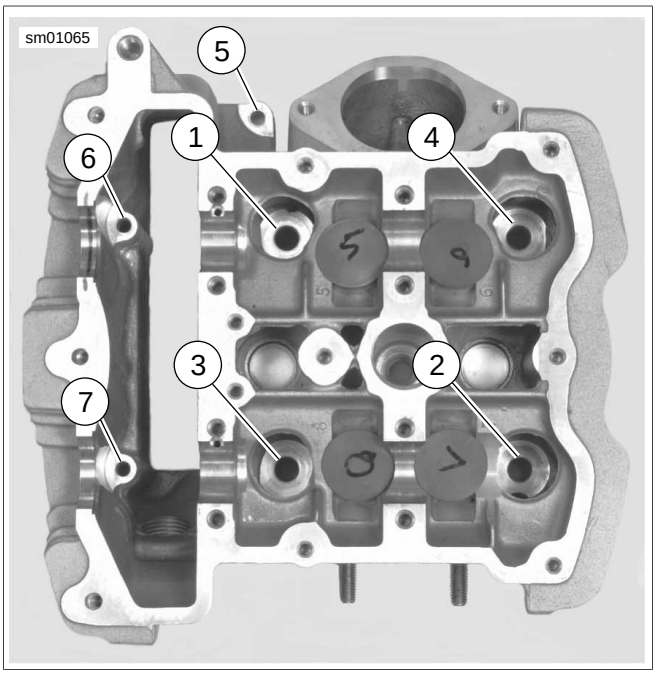



**Figure 3-95. Head Bolt Torque Sequence (rear cylinder head)**

*NOTE*

*For engine rebuild procedure, proceed to 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation to continue engine rebuild.*




**Figure 3-96. Tighten Head Bolts**

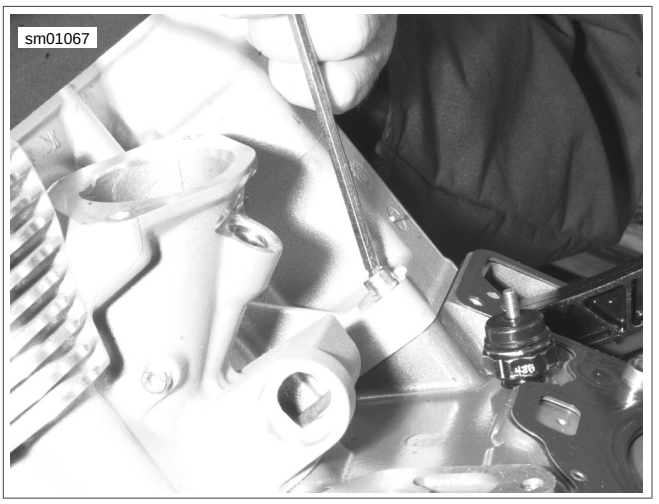



**Figure 3-97. 5 mm Head Fasteners @ 9.7 Nm (86 in-lbs)**

## DISASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45301 | TRANSMISSION ASSEMBLY RETAINER TOOL |
| HD-45304 | ALTERNATOR STATOR COVER REMOVER/INSTALLER |
| HD-45340 | GASKET ALIGNMENT DOWELS |

1. Remove inspection (derby) cover.
2. See Figure 3-98. Remove the 14 fasteners on the alternator cover in reverse order of torque sequence.
3. Install GASKET ALIGNMENT DOWELS (Part No. HD-45340) in two of the alternator cover holes to steady the cover as it is removed.
4. See Figure 3-99. Using the inspection cover fasteners, position the ALTERNATOR STATOR COVER REMOVER/INSTALLER (Part No. HD-45304) as shown.
5. See Figure 3-100. Remove the alternator cover.
6. Remove the clutch side crankcase cover fasteners in reverse order of torque sequence. See 7.2 CLUTCH.
7. Remove the clutch cover.
8. Remove clutch assembly.

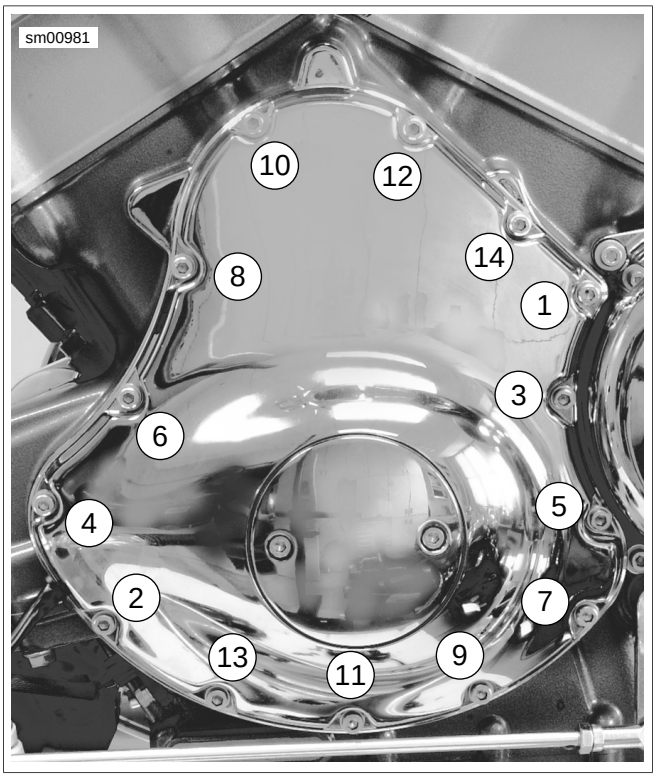



**Figure 3-98. Alternator Cover Torque Sequence Fasteners @ 9.7 Nm (86 in-lbs)**

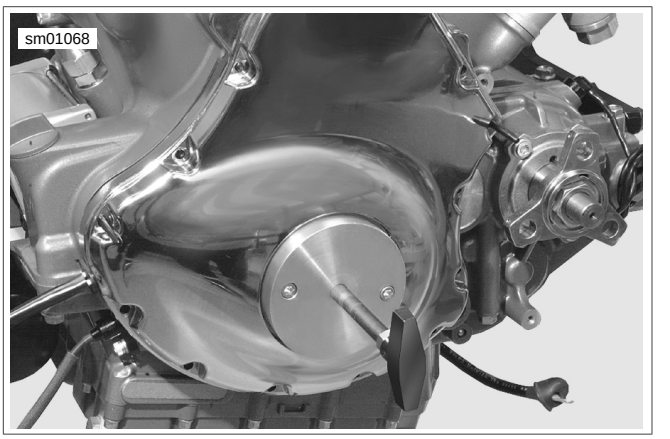



**Figure 3-99. Position Tool HD-45304**

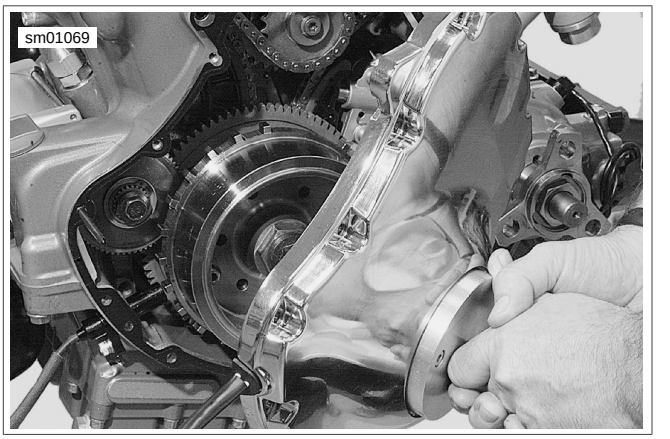



**Figure 3-100. Remove Alternator Cover**




**Figure 3-101. Remove Clutch Cover**

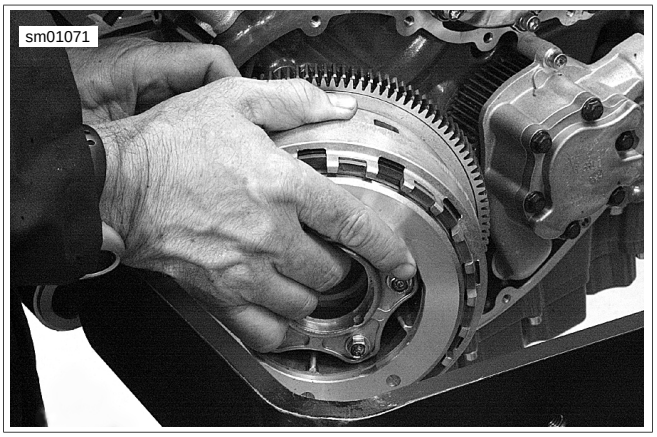



**Figure 3-102. Remove Clutch Assembly**

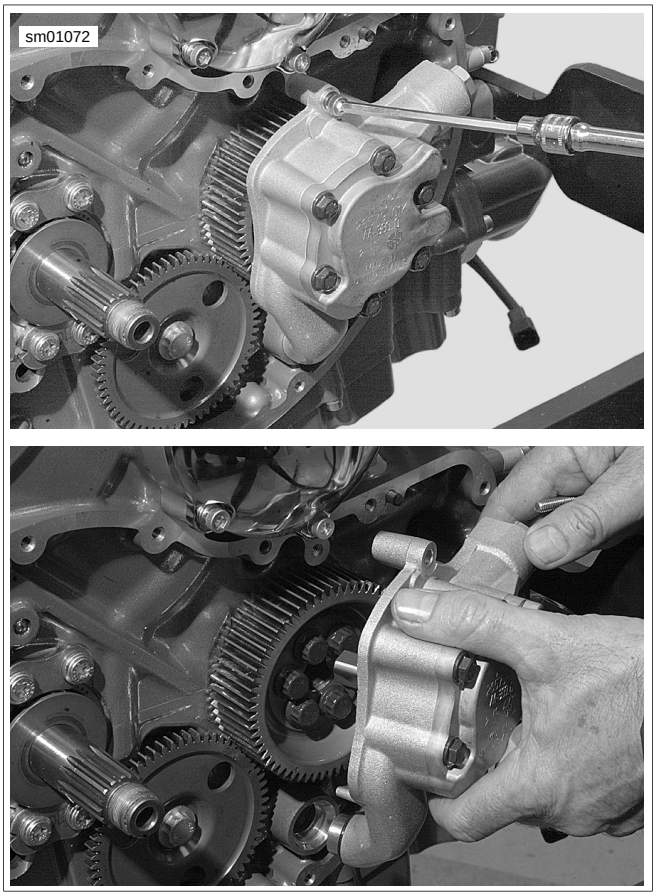



**Figure 3-103. Oil Pump**

9. See Figure 3-103. Remove three fasteners holding oil pump in case.
10. Using a 1/2 in. drive extension and breaker bar, rotate engine in direction of normal engine rotation until timing marks on the crank gear and counterbalancer gear are aligned.

**CAUTION**

**Do not use Counterbalancer Alignment Pin to remove or tighten counterbalancer fastener. Pin can bend and bind in hole. (00550b)**

11. See Figure 3-104. Hold crankshaft with 1/2 in. drive extension and wrench to loosen counterbalancer drive gear fastener. The gear and fastener can be left in place or removed.

*NOTES*

- *The counterbalancer gear fastener can only be broken loose before the case halves are separated and the crankshaft is still in place.*
- *If the alternator rotor is to be removed from the crankshaft, the rotor fastener can be broken loose while holding the crankshaft drive gear with a 1/2 in. drive extension and wrench.*
- *If the starter limiter gear is to be removed, the starter limiter fastener can be broken loose while holding the crankshaft drive gear with a 1/2 in. drive extension and wrench.*
- *If the cam drive is to be removed as part of top end disassembly, break loose the cam drive triple sprocket while holding the crankshaft drive gear with a 1/2 in. extension and wrench.*

12. See Figure 3-105. Carefully invert engine. Remove oil pan. Note position of engine ground cable for assembly.
13. See Figure 3-106. Remove oil pickup and gasket/baffle.

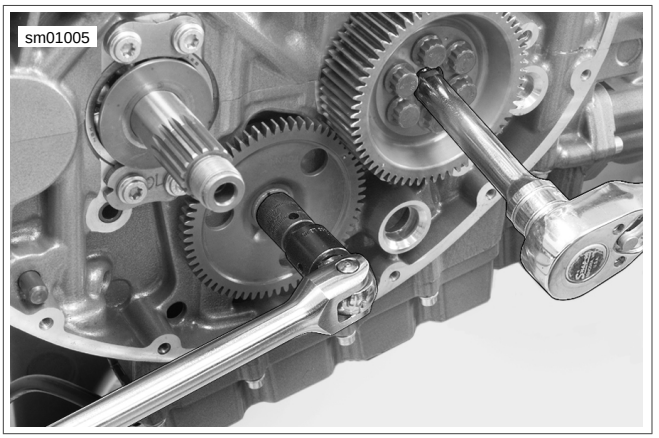



**Figure 3-104. Crank Held to Loosen Fastener**

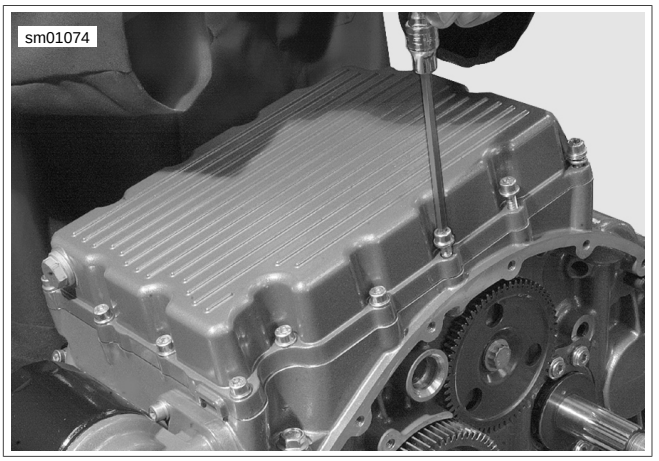



**Figure 3-105. Oil Pan Removal**

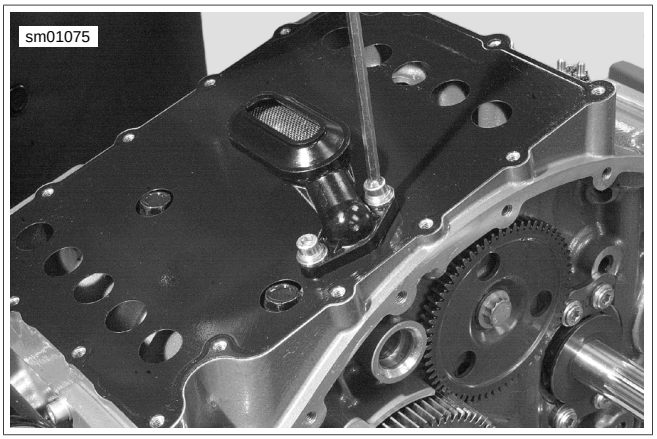



**Figure 3-106. Oil Pickup**

14. See Figure 3-107. Loosen, but do not remove, the input bearing retainer fasteners.
15. See Figure 3-108. Install TRANSMISSION ASSEMBLY RETAINER TOOL (Part No. HD-45301) on the input shaft.
16. See Figure 3-109. Loosen all four output shaft seal retainer fasteners. Remove the two fasteners from the upper case, leaving the loosened lower case fasteners in place. These fasteners will keep the transmission positioned in the lower crankcase.
17. See Figure 3-110. Remove the 19 case fasteners by first loosening each fastener 1/4 turn in reverse order of torque sequence to slowly relieve torque stress. Once all fasteners have been loosened 1/4 turn then they may be removed in the reverse order of torque sequence.
18. Carefully separate the case halves. Use of a rubber mallet may be necessary to loosen the sealed case halves.

*NOTE*

*Do not pry on sealing surfaces to separate case halves. Engine damage and/or case leaks may result.*

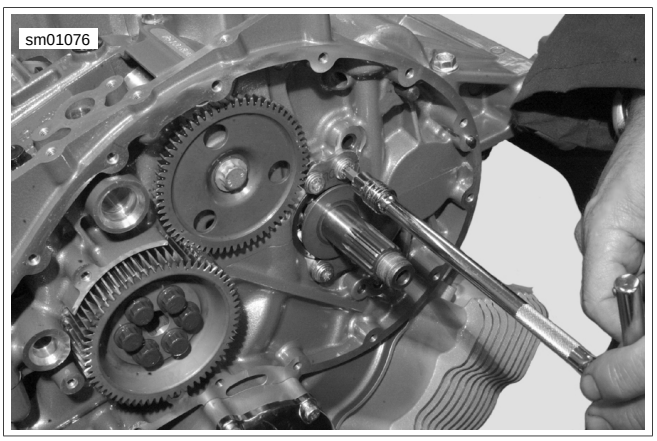



**Figure 3-107. Input Bearing Retainer**

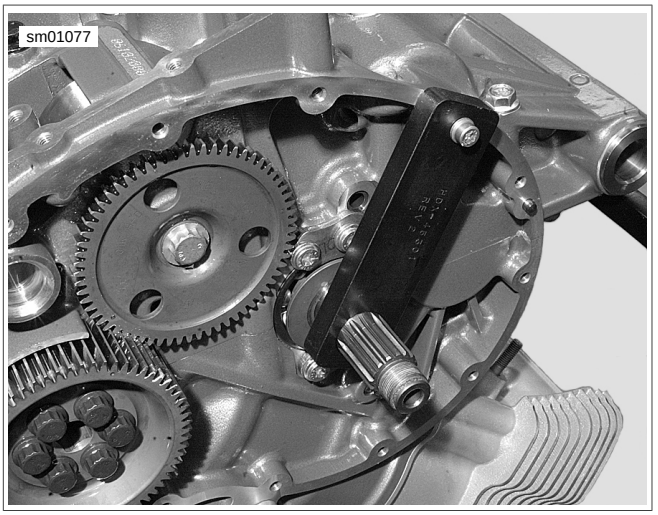



**Figure 3-108. Input Shaft Retainer**

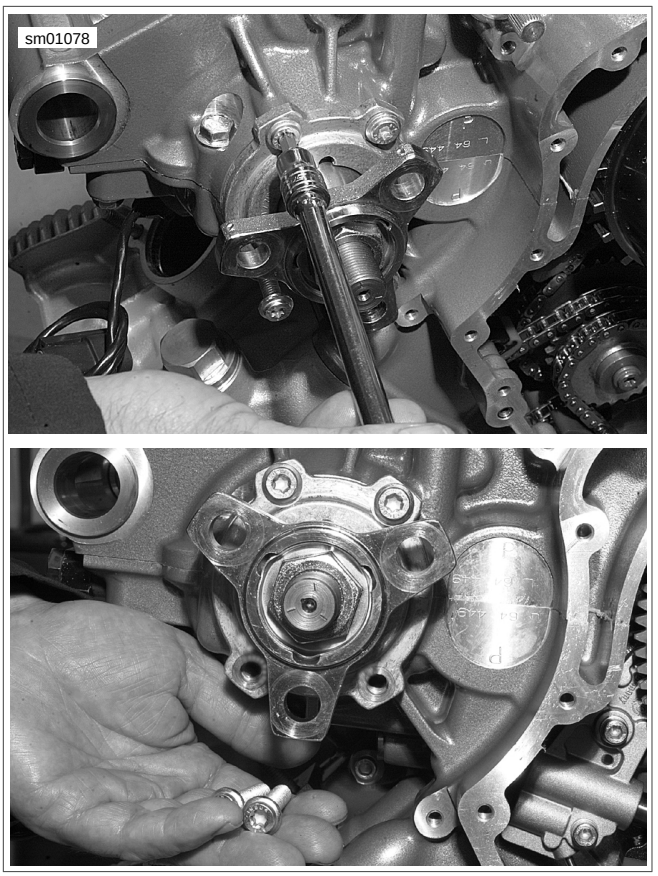
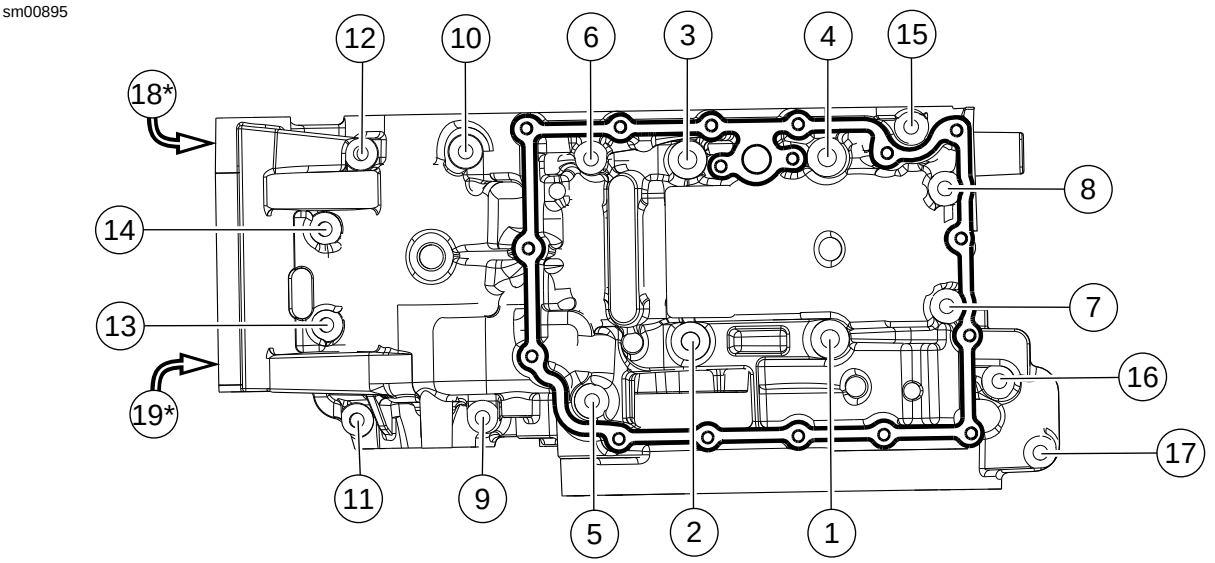



**Figure 3-109. Drive Sprocket Flange Seal Retainer**




1. **M10x150 (Part No. 968M)**
2. **M10x150 (Part No. 968M)**
3. **M10x150 (Part No. 968M)**
4. **M10x150 (Part No. 968M)**
5. **M8x120 (Part No. 973M)**
6. **M8x160 (Part No. 972M)**
7. **M8x90 (Part No. 1025M)**
8. **M8x90 (Part No. 1025M)**
9. **M8x120 (Part No. 973M)**
10. **M8x120 (Part No. 973M)**
11. **M8x40 (Part No. 970M)**
12. **M8x90 (Part No. 1025M)**
13. **M8x40 (Part No. 970M)**
14. **M8x40 (Part No. 970M)**
15. **M8x90 (Part No. 1025M)**
16. **M8x40 (Part No. 970M)**
17. **M8x40 (Part No. 970M)**
18. **M8x40 (Part No. 970M) (*insert from upper case half)**
19. **M8x40 (Part No. 970M) (*insert from upper case half)**

**Figure 3-110. Engine Case Torque Sequence**

*NOTE*

*Lower case with the transmission gears in place is heavy. Get assistance when lifting lower case.*

19. Lift lower case by swingarm pivot housing and oil filter can.

*NOTES*

- *Whenever case halves are separated for service the crankshaft bearings MUST BE REPLACED. Failure to replace bearings will result in engine damage.*
- *To continue engine disassembly, go to 3.11 ENGINE BOTTOM END SERVICE. For transmission service, see 7.3 TRANSMISSION.*

## CRANKSHAFT, PISTON AND CYLINDER LINER REMOVAL/INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-44358 | FLYWHEEL SUPPORT FIXTURE |
| HD-45306 | CRANKSHAFT LOCKING PIN |
| HD-45313 | CYLINDER LINER REMOVER/INSTALLER |
| HD-45316 | CRANKSHAFT ASSEMBLY RETAINER |
| HD-47189 | PISTON PIN REMOVAL AND INSTALLATION TOOL |
| HD-96333-105 | PISTON RING COMPRESSOR |
| SNAP-ON PART NO. TA360 | TORQUE ANGLE GAUGE |
| SNAP-ON TA360 | TORQUE ANGLE GAUGE |

1. See Figure 3-111. Install CRANKSHAFT ASSEMBLY RETAINER (Part No. HD-45316).

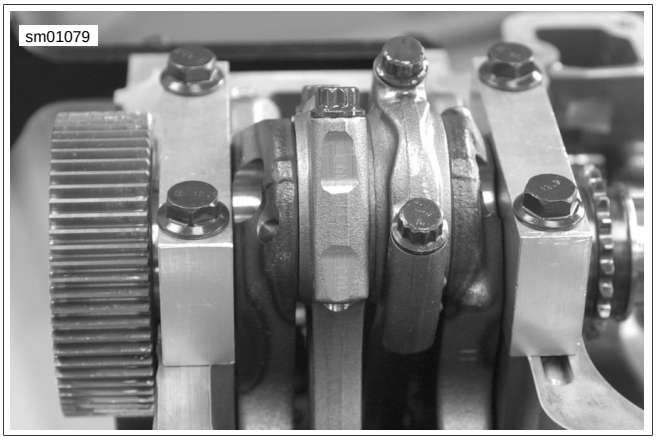



**Figure 3-111. Install Crankshaft Assembly Retainers (HD-45316)**

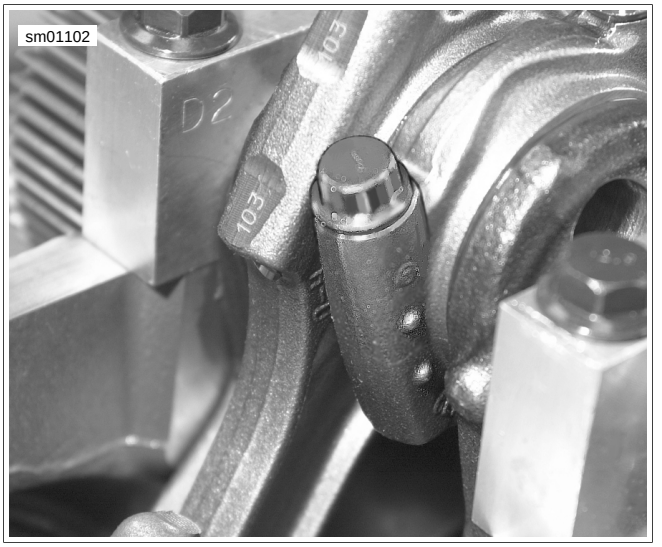



**Figure 3-112. Connecting Rod Orientation**

2. See Figure 3-112. Note the casting bumps on the connecting rods and caps. The rear cylinder must have the bumps toward the water pump side and the front cylinder toward the cam drive side.

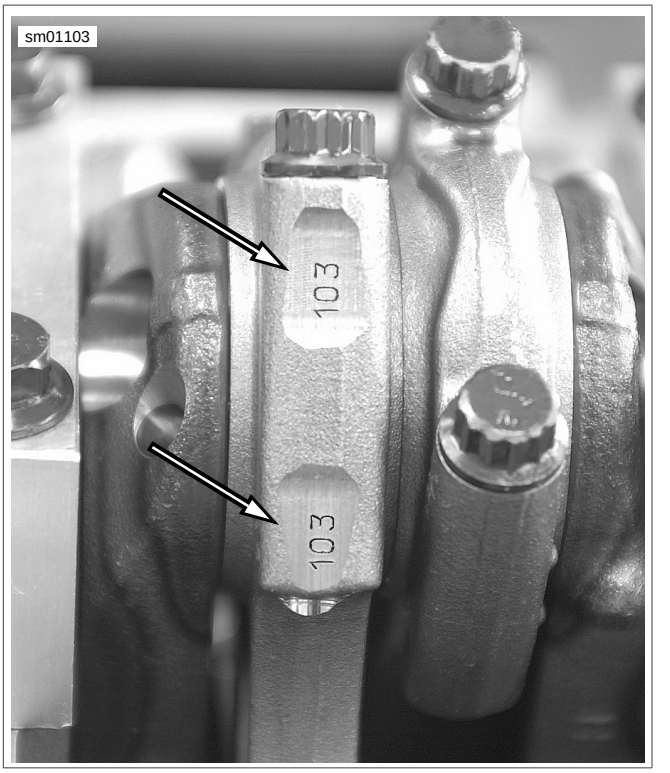



**Figure 3-113. Match Rod and Cap**

3. See Figure 3-113. Note the numbers on connecting rod and cap. Connecting rods and caps must be used in matched sets.

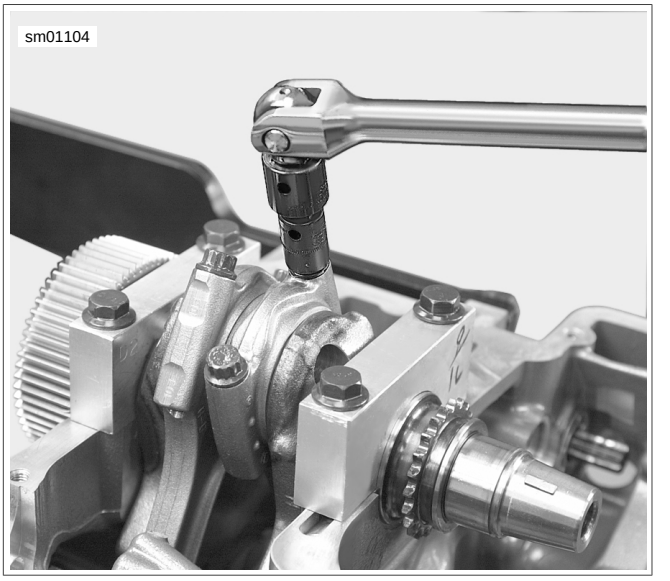



**Figure 3-114. Loosen Rod Cap Fasteners**

4. See Figure 3-114. Loosen connecting rod caps fasteners.
5. Remove the CRANKSHAFT ASSEMBLY RETAINERS.

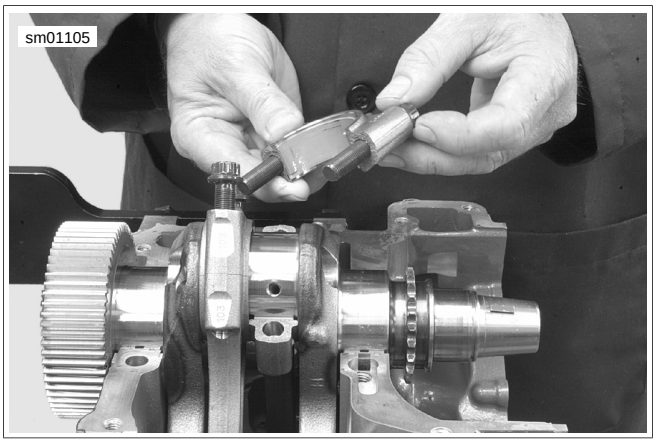



**Figure 3-115. Remove Rod Caps**

6. See Figure 3-115. Inspect connecting rod bearing shells. Look for scoring or discoloration.

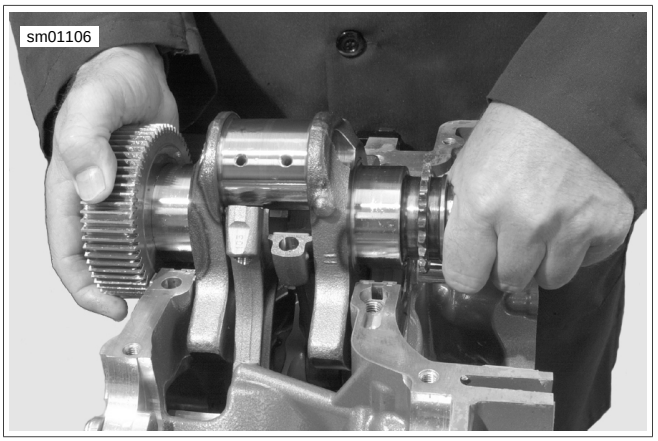



**Figure 3-116. Remove Crankshaft**

7. See Figure 3-116. Remove crankshaft.

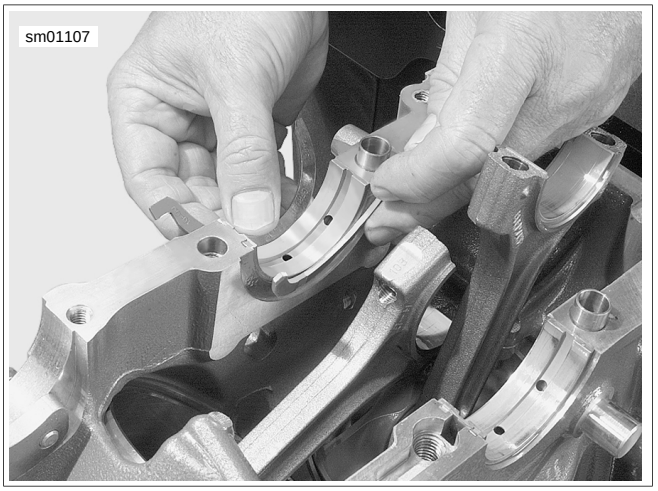



**Figure 3-117. Remove Main Bearing Retainers**

8. See Figure 3-117. Remove crankshaft thrust bearings.

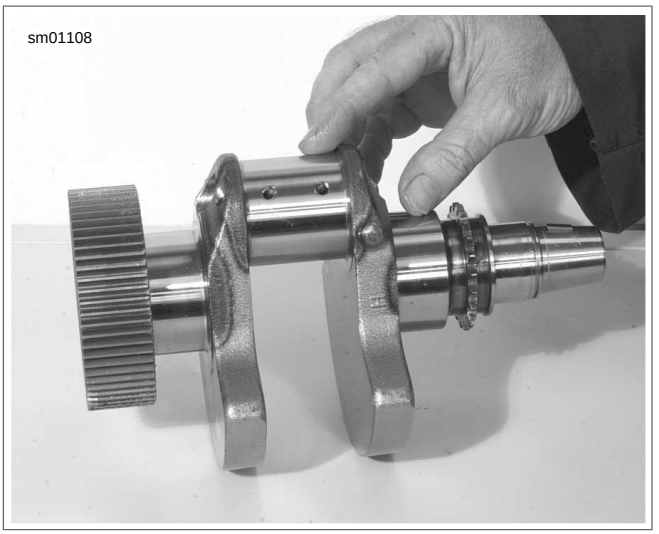



**Figure 3-118. Inspect Crankshaft**

9. See Figure 3-118. Check journals for scoring, bluing and surface damage. Check main drive gear for wear or missing teeth.

*NOTE*

*Mild bluing around crankshaft journal and sprocket edges is due to heat treating process and is normal. However, metal transfer and bluing on journal surface indicates damage and crankshaft must be replaced.*

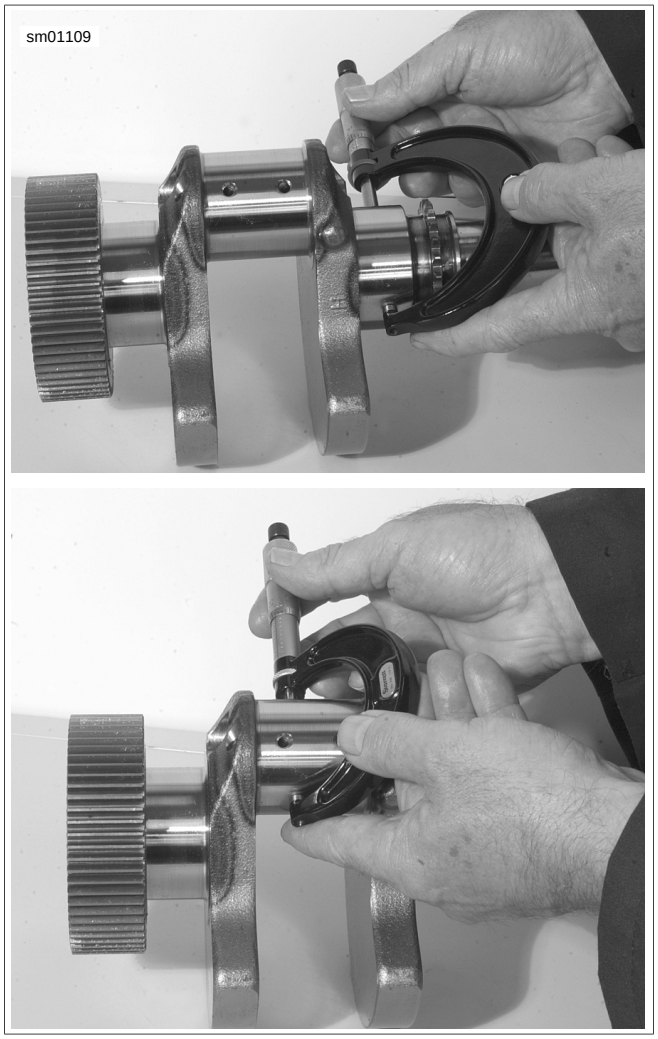



**Figure 3-119. Measure Journal**

10. See Figure 3-119. Measure crankshaft journals. For crankshaft bearing selection. Refer to Table 3-24.




**Figure 3-120. Mark Connecting Rods**

11. See Figure 3-120. If rods are to be reused, mark them F (front) and R (rear). Rod must be installed in the same position.

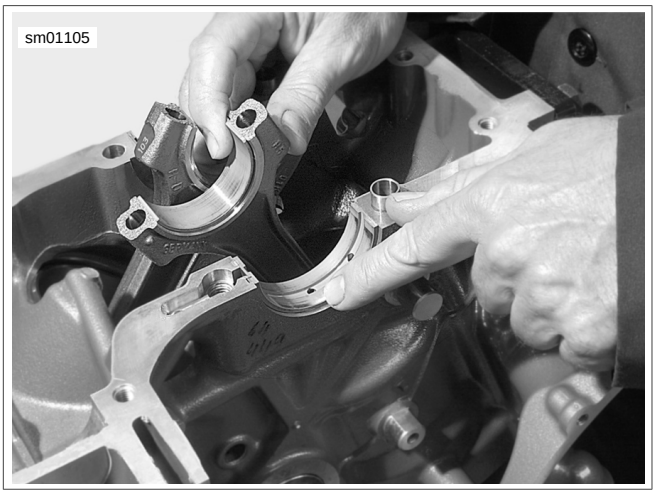



**Figure 3-121. Bearing Shells**

12. See Figure 3-121. Inspect bearing shells for scoring or discoloration.

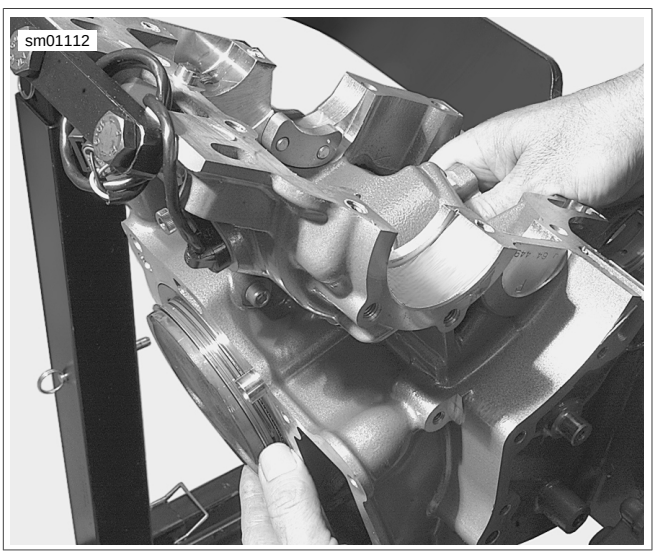



**Figure 3-122. Remove Pistons**

13. See Figure 3-122. Carefully push piston and rod out top of cylinder. Avoid contacting piston jet. Do not let the connecting rod contact the cylinder liner wall.




**Figure 3-123. Wrist Pin Retaining Rings**

14. See Figure 3-123. Remove and discard wrist pin retaining rings using PISTON PIN REMOVAL AND INSTALLATION TOOL (Part No. HD-47189).

*NOTE*

*If new pistons are not to be used, do not remove pistons.*

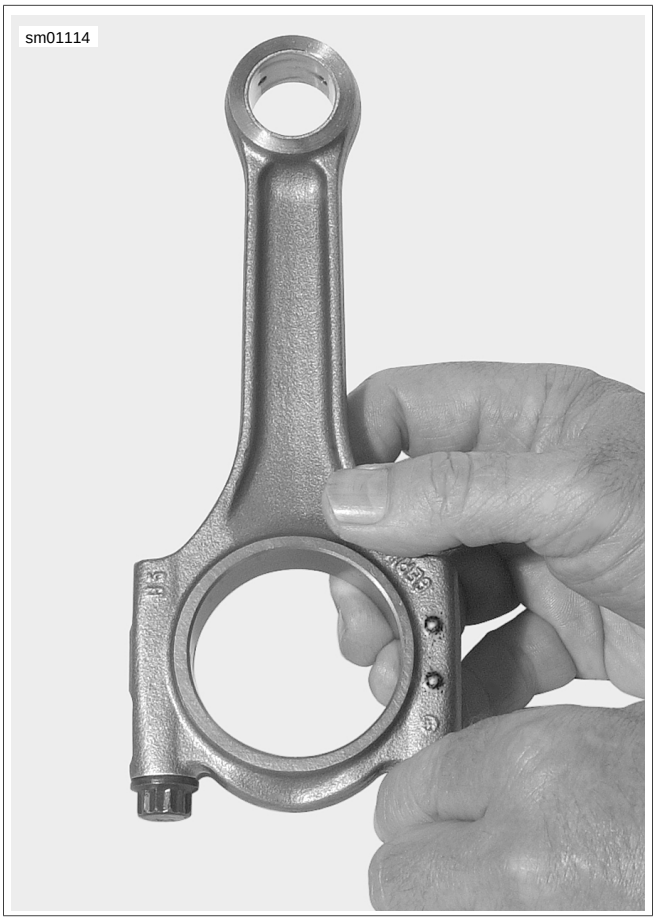



**Figure 3-124. Install Rod Caps for Inspection**

**WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

15. See Figure 3-124 Note rod and cap identifying numbers and casting bumps. Install rod caps and tighten to 27 Nm (20 ft-lbs). Position the TORQUE ANGLE GAUGE (Part No. Snap-on TA360) per instruction sheet and tighten connecting rod bolts an additional 90°.

*NOTE*

*The notation for this torque sequence is written:*

*27 Nm + 90°*

16. See Figure 3-125. Check big end dimensions with a dial bore gauge. Measurement must be between a maximum of 51.616 mm (2.032 in.) and a minimum of 51.60 mm (2.031 in.).

17. See Figure 3-126. Inspect small end bushing and wrist pin fit. The running clearance should be between a maximum of 0.033 mm (0.001 in.) and a minimum of 0.018 mm (0.0007 in.).




**Figure 3-125. Measure Big End**

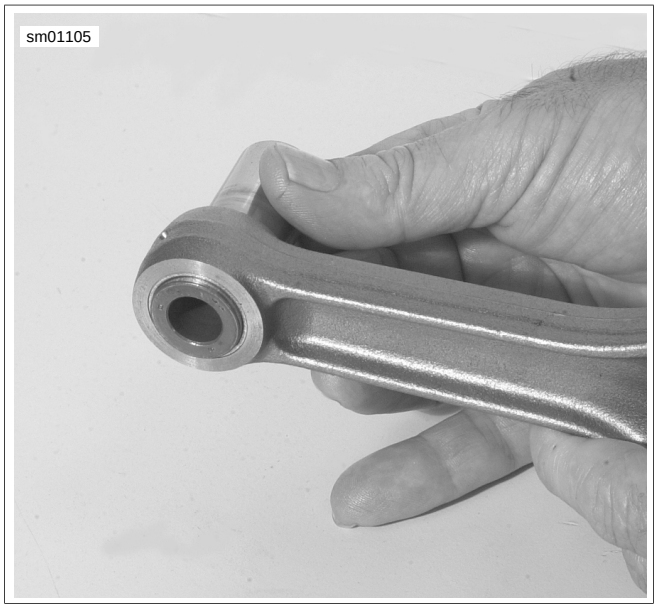



**Figure 3-126. Inspect Small End**




**Figure 3-128. Piston Orientation Mark**

18. See Figure 3-127. Measure piston diameter on thrust surface.
19. See Figure 3-128. EX on piston top goes toward the exhaust valves. Front piston EX will go toward the front of the engine. Rear piston EX will go toward the rear of the engine.




**Figure 3-127. Piston Measurement**

20. See Figure 3-129. FLYWHEEL SUPPORT FIXTURE (Part No. HD-44358) can be modified to hold crankshaft when removing or installing primary drive gear. Open bore of center hole to 59.7 mm (2.350 in.).
21. See Figure 3-130. Remove and discard primary drive gear fasteners.

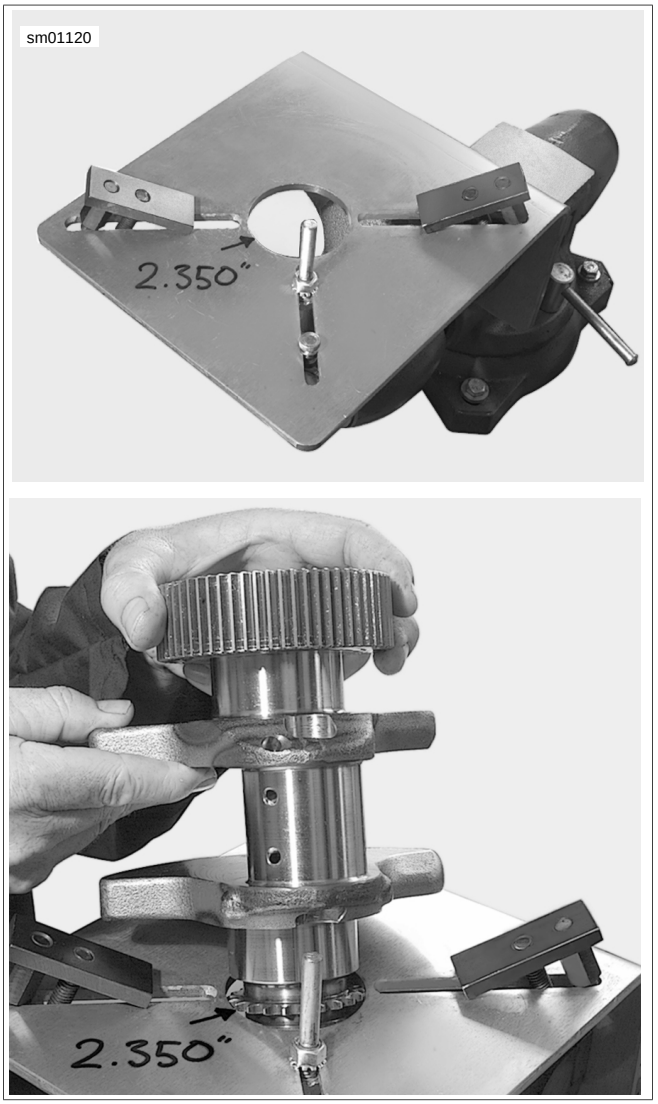



**Figure 3-129. Flywheel Support Fixture**

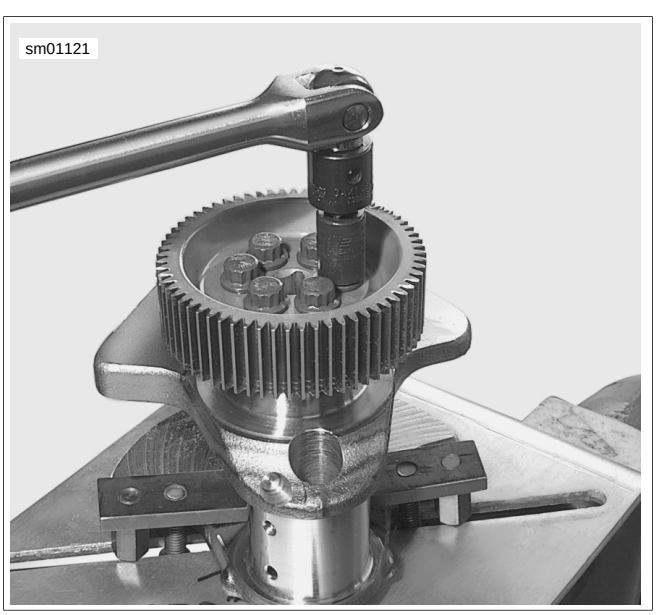



**Figure 3-130. Remove Primary Gear**

22. See Figure 3-131. Examine primary drive gear. Inspect thrust surfaces for excessive wear or chipping. Note the timing marks on the primary drive gear and the crankshaft. Assemble with the timing mark on the drive gear over the timing mark on the crankshaft.
23. See Figure 3-132. Lubricate **new** primary drive gear fasteners with Harley-Davidson Motorcycle Oil 20W50. Lubricate threads and under head of bolt.
24. See Figure 3-133. Using a crisscross pattern, tighten the primary gear fasteners to 10 Nm (88 **in-lbs**) Position the TORQUE ANGLE GAUGE (Part No. Snap-on Part No. TA360) per instruction sheet and tighten bolt an additional 90°.




**Figure 3-131. Primary Gear Timing Marks**




**Figure 3-132. Installing Primary Gear**

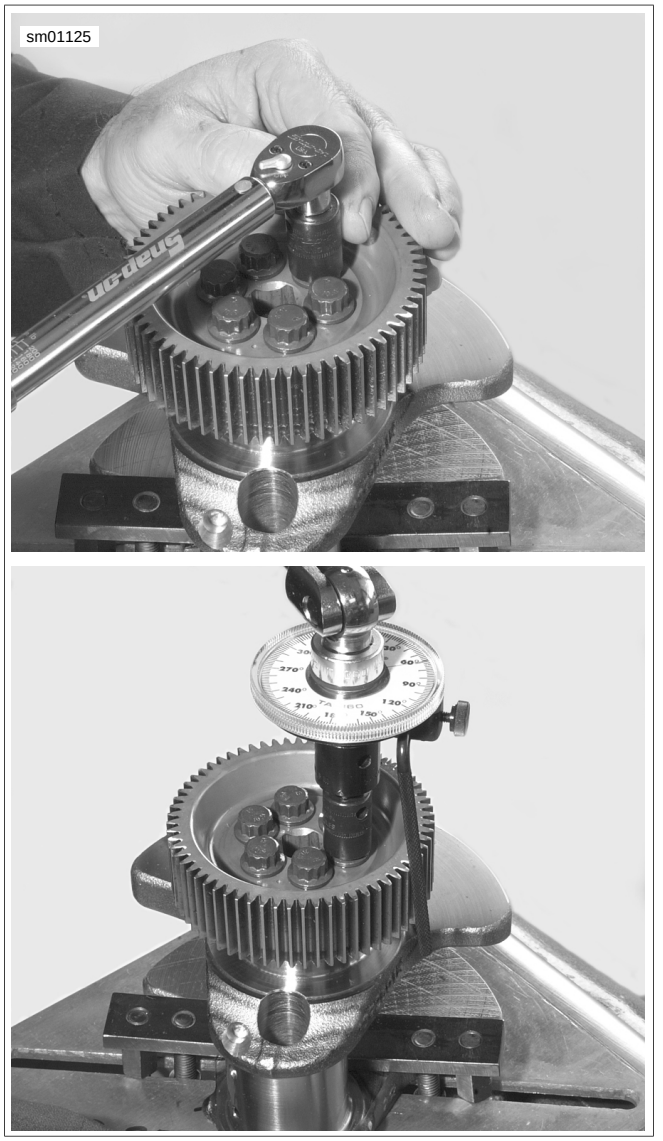



**Figure 3-133. Tighten Primary Gear**




**Figure 3-134. Measure Cylinder Bore**

25. See Figure 3-134. Using a dial bore gauge, check cylinder concentricity. See specifications for serviceability.

*NOTE*

*If cylinder liner is to be removed, mark liner and crankcase so the liner can be installed in the same position. Pick a convenient feature for reference.*

26. See Figure 3-135. Mark case and cylinder liner and install CYLINDER LINER REMOVER/INSTALLER (Part No. HD-45313) .

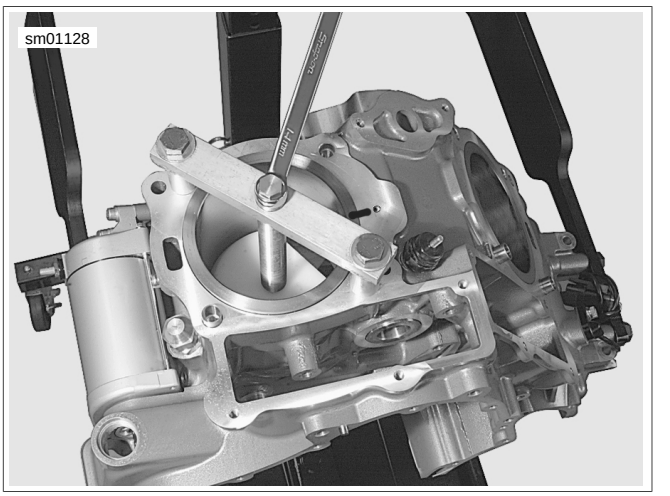



**Figure 3-135. Mark Case and Cylinder Liner and Install CYLINDER LINER REMOVER/INSTALLER (HD-45313)**

27. See Figure 3-136. According to instruction sheet for Cylinder Liner Remover/Installer, remove liner.
28. See Figure 3-137. Inspect piston jet. Piston jet must fit tight and have no visible damage. If loose or damaged crankcase must be replaced.

29. See Figure 3-138. Carefully clean cylinder liner and step in crankcase. Debris in the step could prevent the cylinder liner from fully seating.




**Figure 3-136. Remove Cylinder Liner**

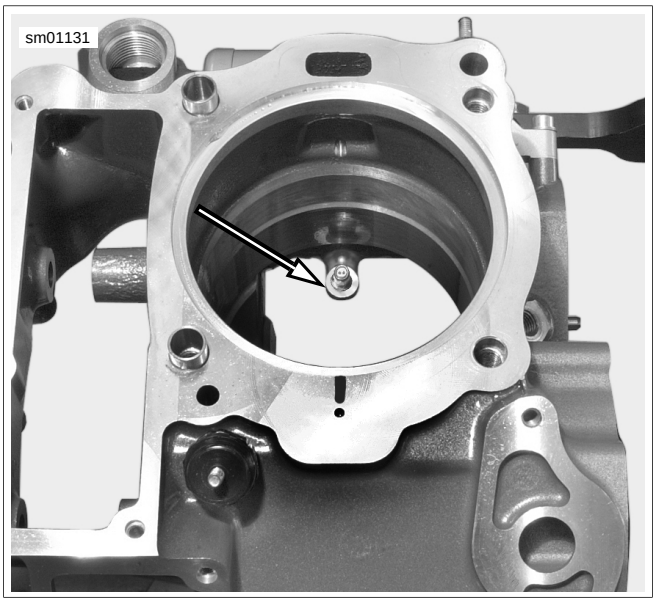



**Figure 3-137. Piston Jet**

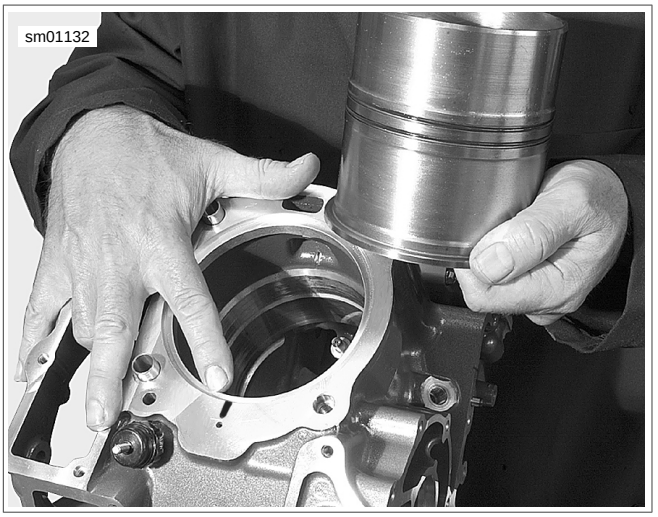



**Figure 3-138. Clean Liner and Case Step**




**Figure 3-139. Lubricate Liner**

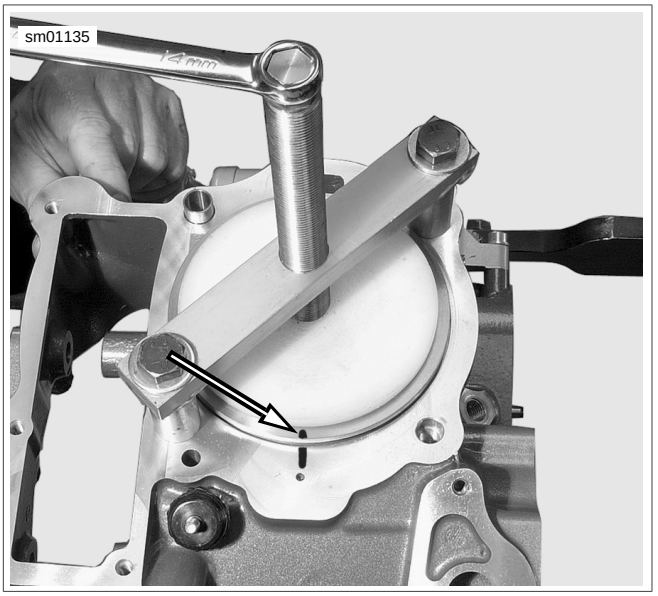



**Figure 3-140. Align Case and Cylinder Marks and Insert Liner**

30. See Figure 3-139. Lubricate o-rings with Harley-Davidson Motorcycle Oil 20W50 to keep o-rings seated on cylinder.
31. See Figure 3-140. Align case and cylinder marks and insert liner in the case bore. Install CYLINDER LINER REMOVER/INSTALLER according to instruction sheet and install liner.
32. See Figure 3-141. Check ring end gap by placing ring in cylinder and measure gap using feeler gauges. See specifications for serviceability.
33. See Figure 3-142. Carefully install piston rings. Second compression ring is installed with the mark to the top. When ring set is installed, gaps must be staggered.

*NOTE*

*If engine is to be assembled at this point, make sure all parts are cleaned and lubricated appropriately.*

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

34. See Figure 3-143. Install wrist pin and wrist pin retaining rings using PISTON PIN REMOVAL AND INSTALLATION TOOL.

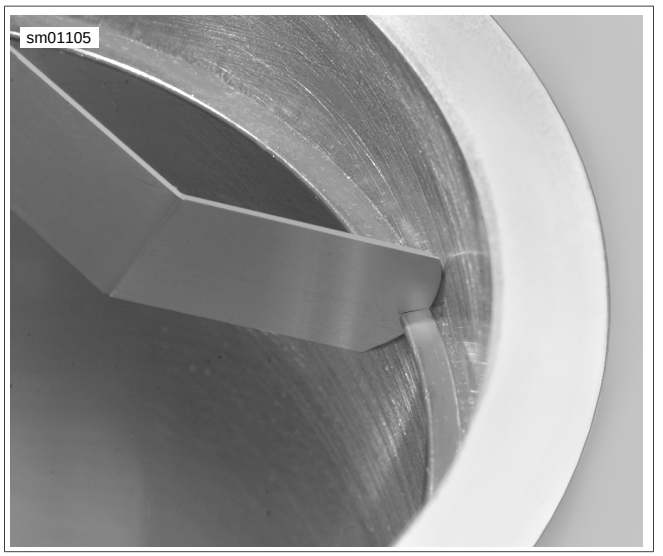



**Figure 3-141. Ring End Gap**

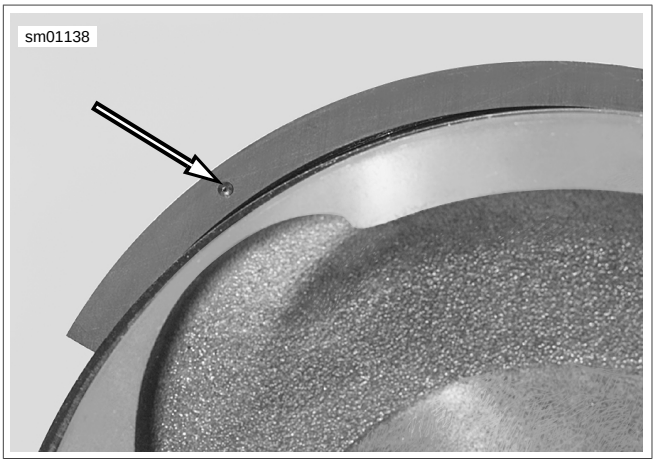



**Figure 3-142. Second Compression Ring Top Mark**




**Figure 3-143. Wrist Pin Retaining Rings**

35. See Figure 3-145. To install piston, complete each of the following steps:
    a. Lightly lubricate inside of PISTON RING COMPRESSOR (Part No. HD-96333-105) and rings and piston skirt with Harley-Davidson Motorcycle Oil 20W50.
    b. See Figure 3-144. Orient the brackets on the compressor ring down (Note arrow on compression ring) toward the crankcase. Orient the squeeze handle parallel to crankcase.

    *NOTE*

    *Failure to install pistons correctly oriented will result in engine failure.*

    c. Orient piston and connecting rod to crankcase.

*NOTE*

*Correct piston and connecting rod orientation is as follows:*

d. Front cylinder connecting rod and cap bumps to cam drive side of engine.

e. Rear cylinder connecting rod and cap bumps to water pump side of engine

f. EX mark toward the front on front cylinder

g. EX mark toward the rear on rear cylinder

h. Clamp the PISTON RING COMPRESSOR around rings and pistons.

i. Adjust tension on handle to compress rings but still allow piston and rings to slip out of compressor into cylinder bore.

*NOTE*

*If piston jet is damaged, crankcase will have to be replaced.*

j. See Figure 3-137. With free hand inside crankcase, guide rod past piston jet.

*NOTE*

*Whenever resistance is encountered, stop and examine components. A ring can gouge the cylinder wall when forced.*

k. See Figure 3-145. Using a rubber or wooden mallet handle, very gently tap piston around circumference into bore. Hold constant pressure on the piston ring compressor until rings have entered bore.

l. When piston and rings are in the bore, move piston up and down the bore to ensure rings have not broken during installation.

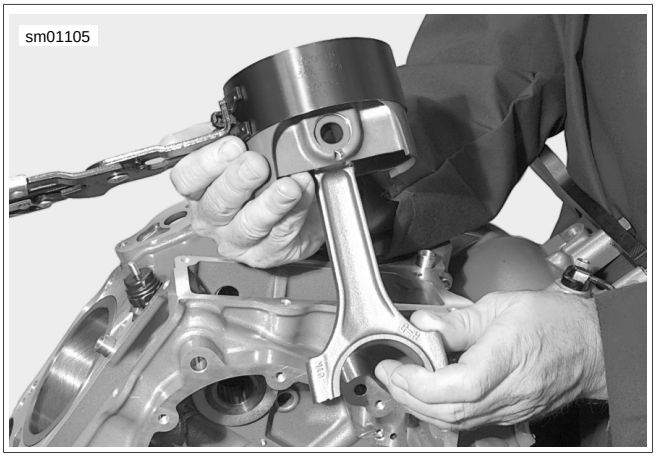



**Figure 3-144. Piston Ring Compressor**

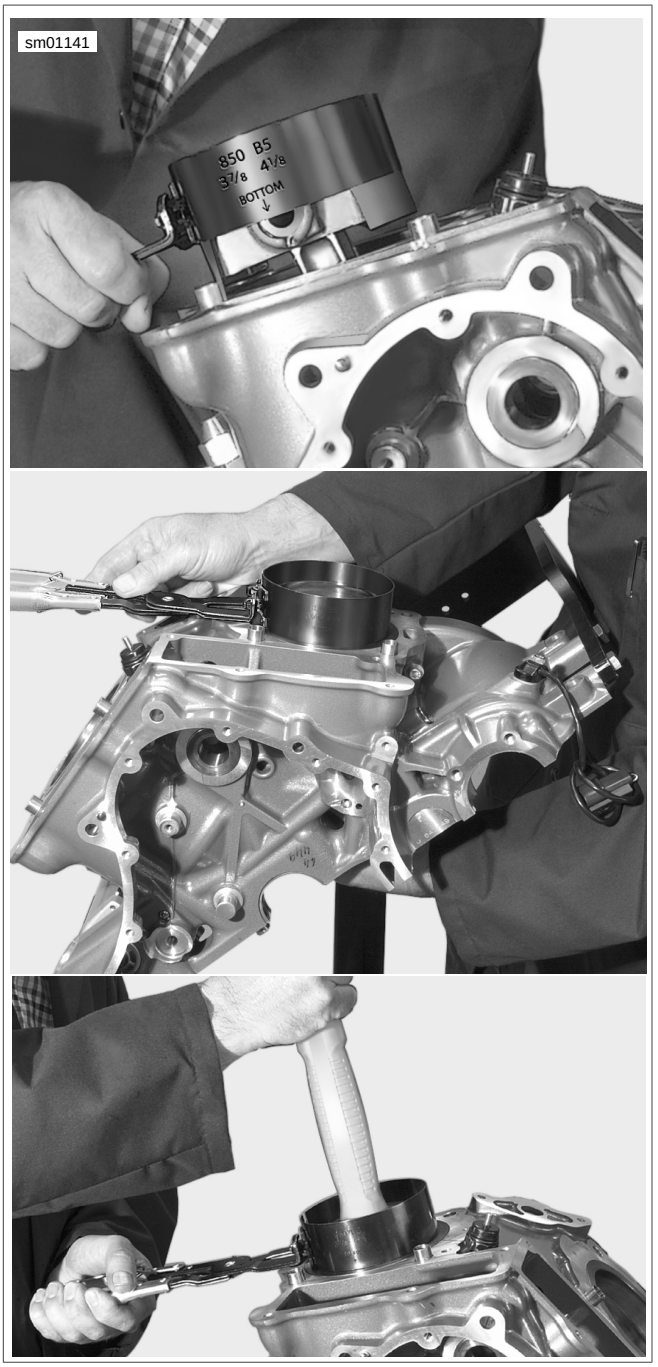



**Figure 3-145. Insert Piston**

36. Invert upper crankcase assembly. Clean connecting rod bore and crank bore making sure its free of oil.

37. See Figure 3-149. Select rod bearing replacement set to match rod bearing journal diameter color code (3) on crankshaft. Refer to Table 3-23.

*NOTE*

*Rod bearing sets (front and rear) are available in two sizes, coded red (R) and blue (B). The rod bearing color code appears on the bearing shell edge.*

*Always measure all bearing surfaces before selecting and installing bearings.*

**Table 3-23. Rod Bearing Journal Diameter**

| COLOR CODE | H-D PART NO. | SPECIFICATION | |
|---|---|---|---|
| Red | 24412-01K | Max | 47.991 mm |
| | | Min | 47.983 mm |
| Blue | 24413-01K | Max | 47.983 mm |
| | | Min | 47.975 mm |

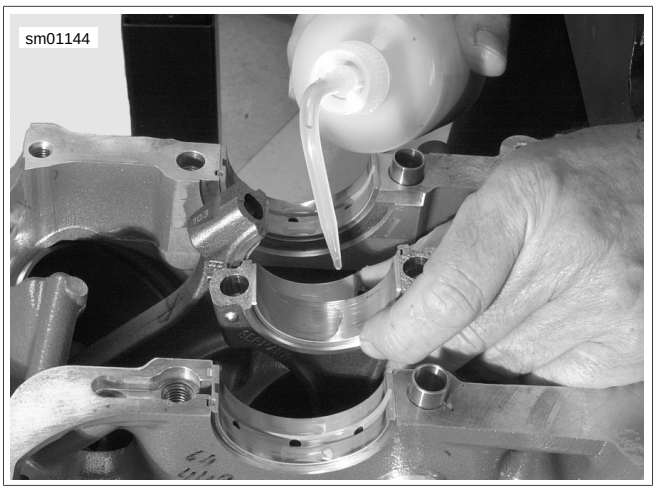



**Figure 3-146. Lubricate Bearings**

38. See Figure 3-146. Install rod bearings and lubricate bearing surface with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

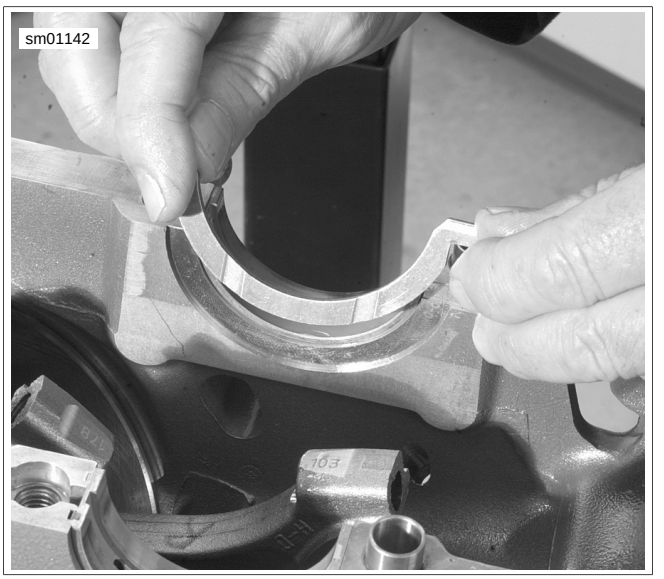



**Figure 3-147. Install Thrust Bearing**

39. See Figure 3-147. Install thrust bearing. Use a small amount of grease on the back of the bearing to hold in position.

40. See Figure 3-148. Move connecting rods so front connecting rod points to rear, and rear rod points to front of engine.

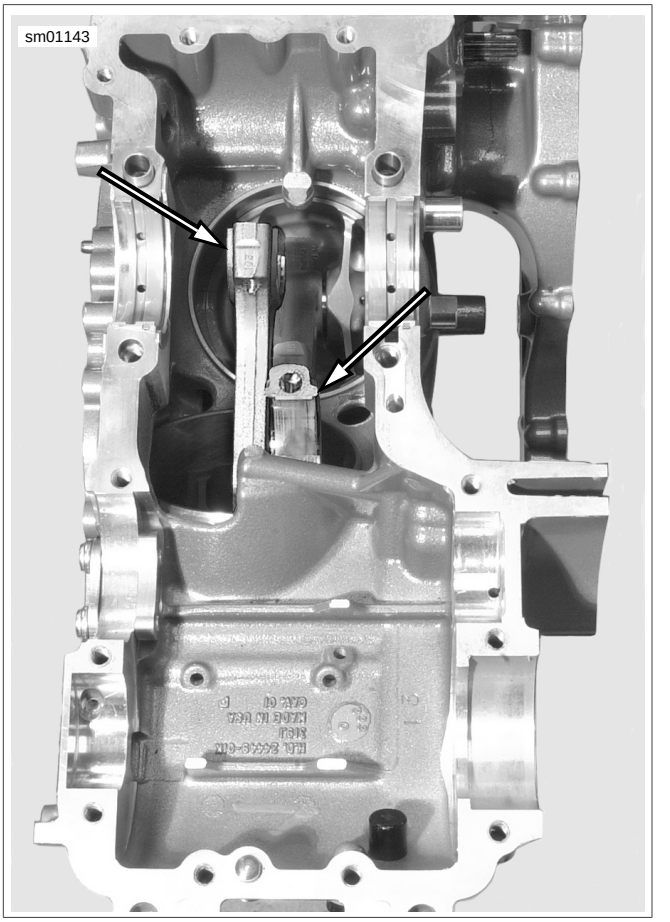
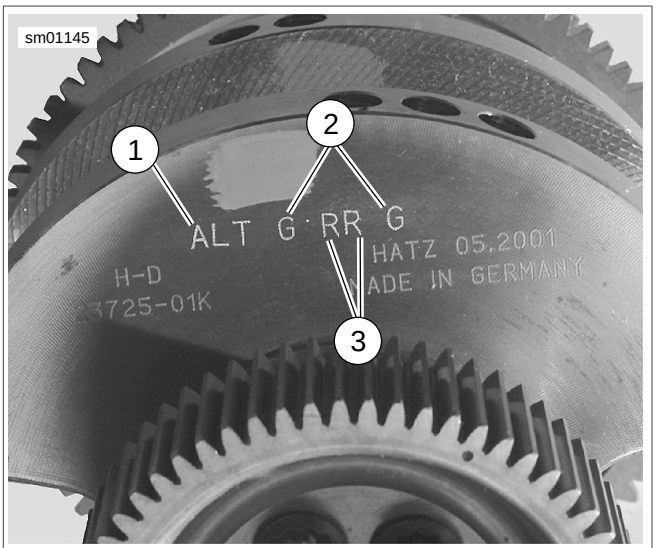



**Figure 3-148. Position Connecting Rods**




1. **ALT (alternator side)**
2. **G (green main bearing code)**
3. **R (red rod bearing code)**

**Figure 3-149. Crankshaft Color Code**

41. See Figure 3-149. Crankshaft counter weight is stamped with the original color code for main bearing and rod journal replacement sets. Read from left to right, the letter code corresponds to the alternator and clutch side main bearing journals (2) and the front rod and rear rod journals (3).

42. Refer to Table 3-24. Select main bearing set corresponding to color code on crankshaft.

*NOTE*

*Always measure all bearing surfaces before selecting and installing bearings.*

**Table 3-24. Rod Bearing Journal Diameter**

| COLOR CODE | H-D PART NO. | | ALTERN-ATOR SIDE | CLUTCH SIDE |
|---|---|---|---|---|
| **B**lue | 24411-01K | Max | 55.977 mm | 55.952 mm |
| | | Min | 55.971 mm | 55.946 mm |
| **G**reen | 24410-01K | Max | 55.984 mm | 55.959 mm |
| | | Min | 55.977 mm | 55.952 mm |
| **R**ed | 24409-01K | Max | 55.990 mm | 55.965 mm |
| | | Min | 55.984 mm | 55.959 mm |

*NOTE*

*Main bearings are available in 3 sets (alternator and clutch side bearings) to fit three sizes of journals. The sets are color coded, blue (B), green (G) and red (R).*

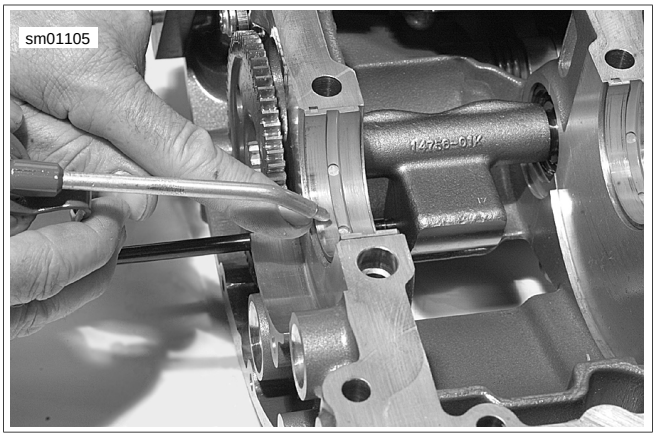



**Figure 3-150. Lubricate Crankshaft Bearings**

43. See Figure 3-150. Install crankshaft bearings and lubricate bearing surface with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

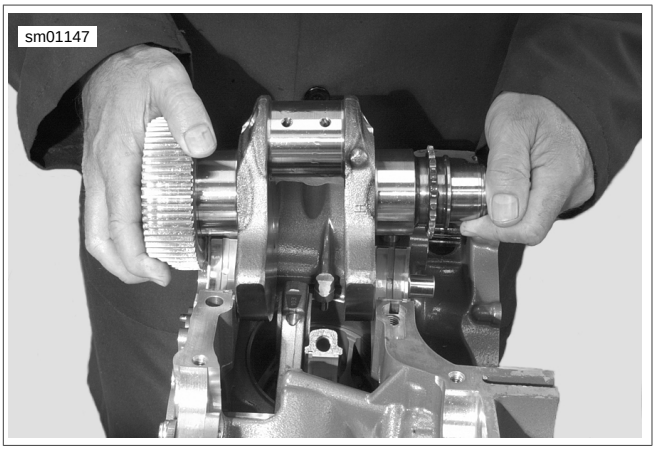



**Figure 3-151. Install Crankshaft**

44. See Figure 3-151. Carefully position crankshaft.

45. See Figure 3-111. When crankshaft is in position install CRANKSHAFT ASSEMBLY RETAINER.

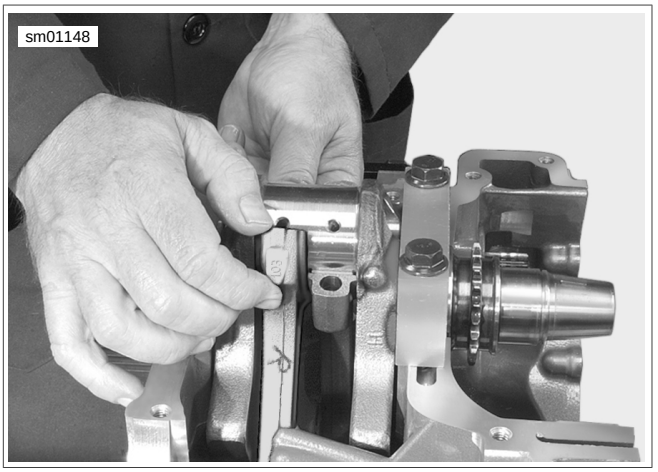



**Figure 3-152. Position Connecting Rods**

46. See Figure 3-152. Pull piston and rod assembly up to crankshaft journal.

47. See Figure 3-154. Lubricate crankshaft journal, connecting rod cap bearings, connecting rod bolt threads and under head of rod cap bolt with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended for the rod bearings.

48. See Figure 3-153. Install connecting rod caps. Confirm connecting rods and caps have identical numbers and cast bumps are oriented correctly.
    a. Front cylinder connecting rod and cap bumps to cam drive side of engine.
    b. Rear cylinder connecting rod and cap bumps to water pump side of engine.

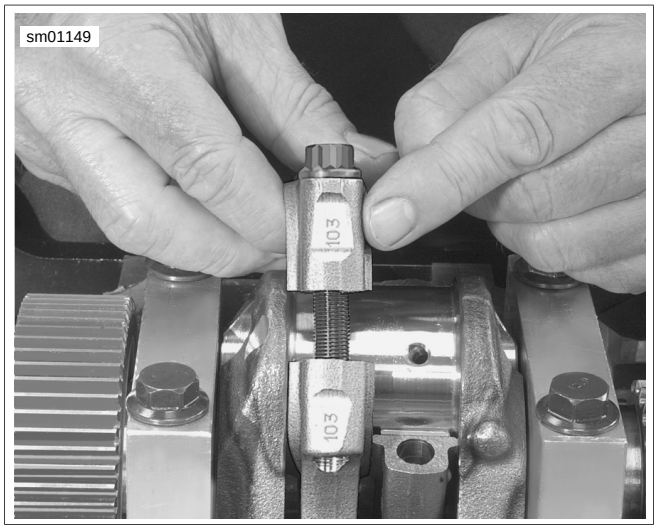



**Figure 3-153. Install Connecting Rod Caps**

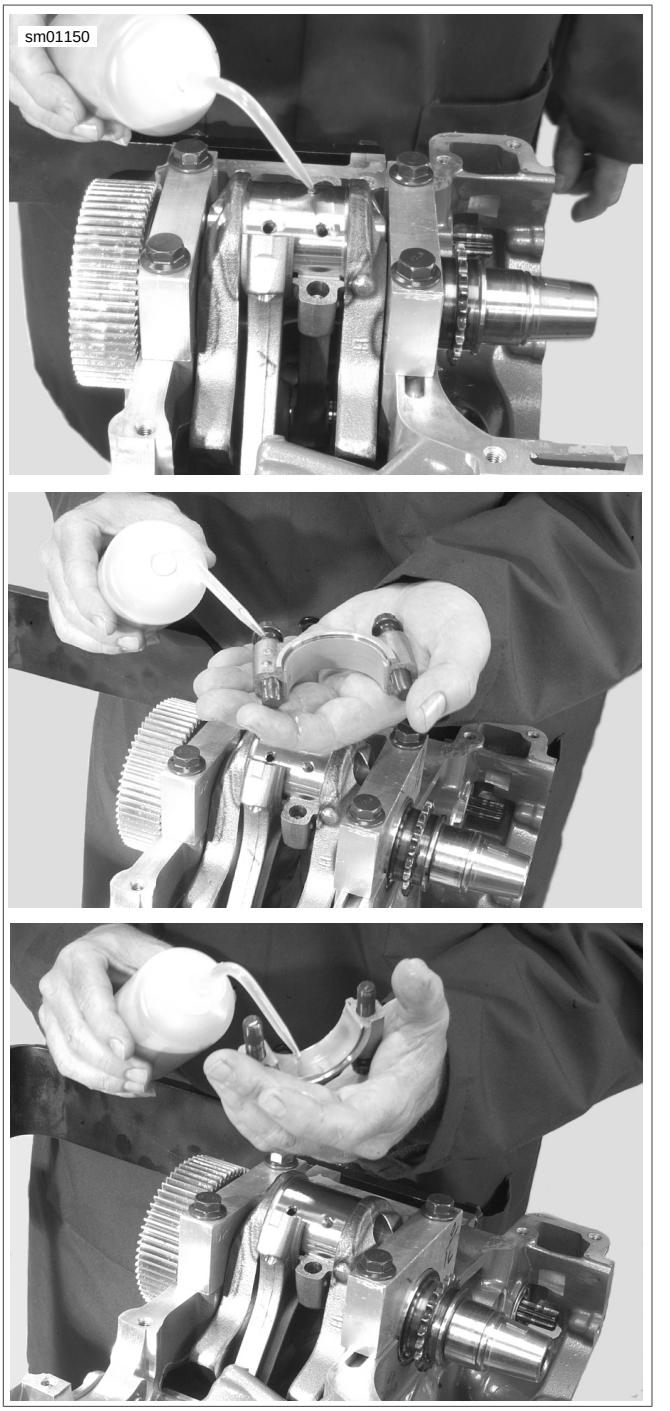



**Figure 3-154. Lubricate Crankshaft and Rods**

49. See Figure 3-155. Tighten connecting rod caps to 27 Nm (**20 ft-lbs**) .
50. See Figure 3-156. Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten connecting rod bolts an additional 90°.

*NOTE*

*The notation for this torque sequence is written:*

*27 Nm + 90°*

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

51. When all rod bolts are correctly torqued, turn engine to locate front piston at TDC and insert CRANKSHAFT LOCKING PIN (Part No. HD-45306).

*NOTE*

*For engine rebuild procedure, proceed to 3.9 CYLINDER HEAD, Installation to continue engine rebuild.*

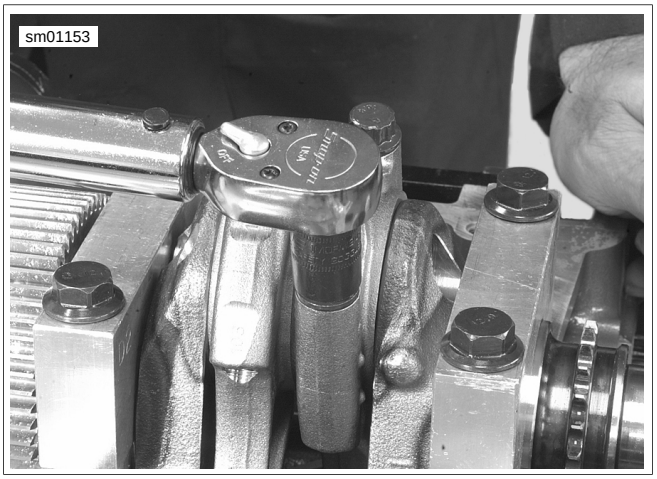



**Figure 3-155. Install Connecting Rod Caps**

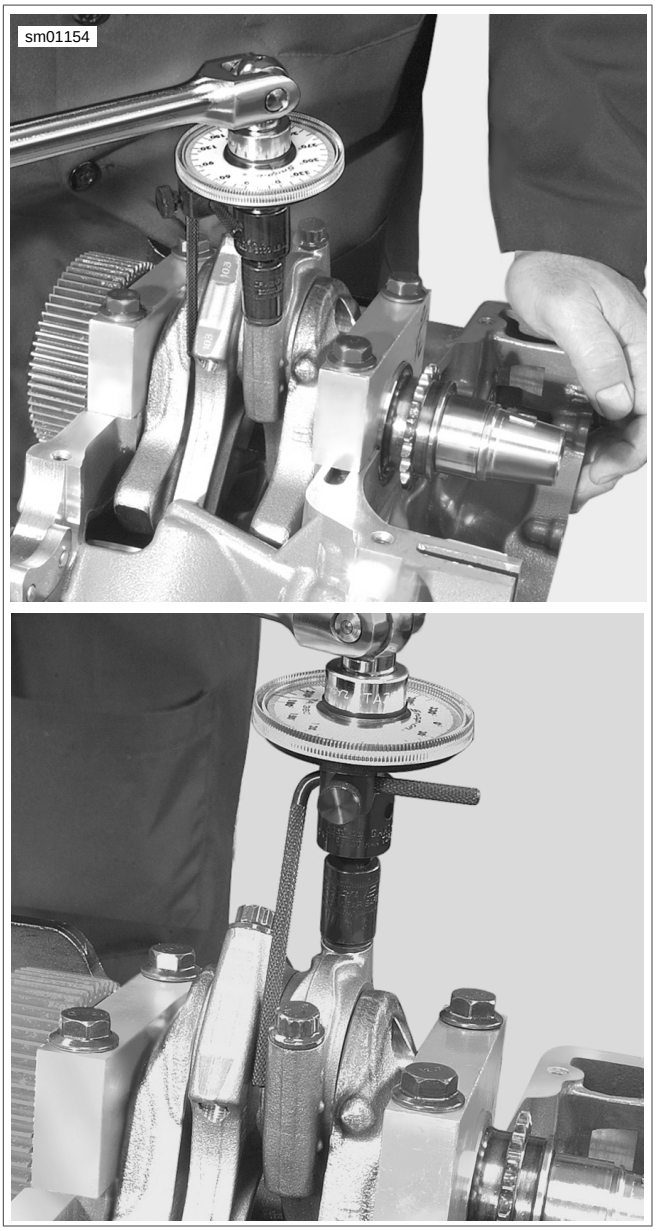



**Figure 3-156. Tighten Connecting Rod Caps**

## OIL PUMP

1. See Figure 3-157. With oil pump on engine, loosen bypass fastener and front cover fasteners.
2. See Figure 3-158. Remove three fasteners holding oil pump in case.
3. See Figure 3-159. Remove bypass valve assembly. Examine valve piston and valve piston bore in pump housing. There should be no scoring and valve piston should move freely in the bore without sticking.
4. See Figure 3-160. Examine gerotor. Replace parts showing scoring. Note assembly marks on the gerotor. Marks must be on the same side when assembling.

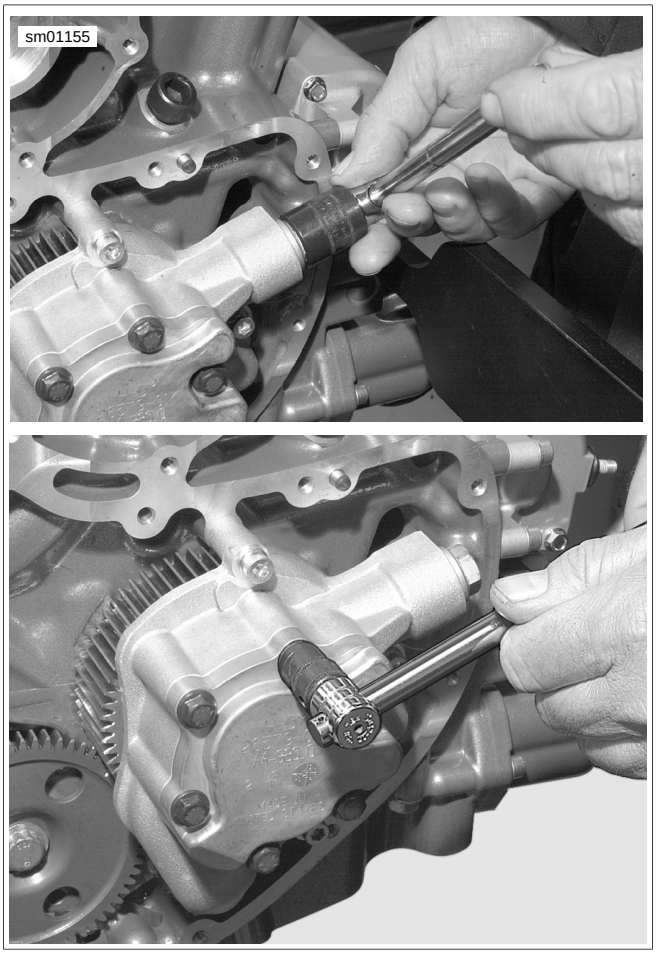



**Figure 3-157. Oil Pump Fasteners**

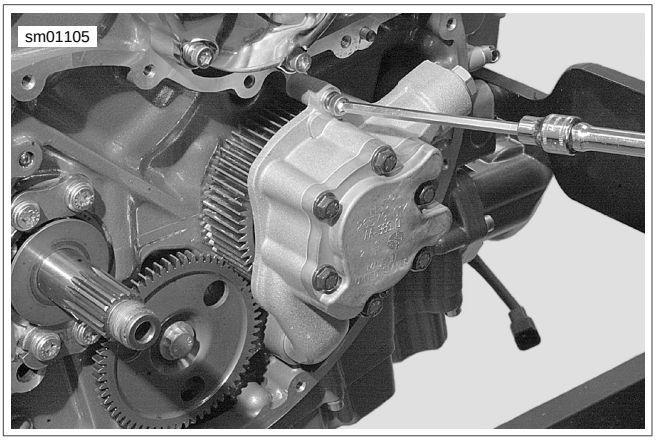



**Figure 3-158. Remove Oil Pump**

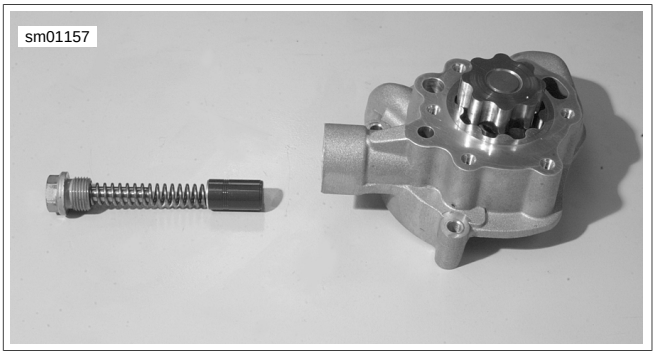



**Figure 3-159. Bypass Valve**

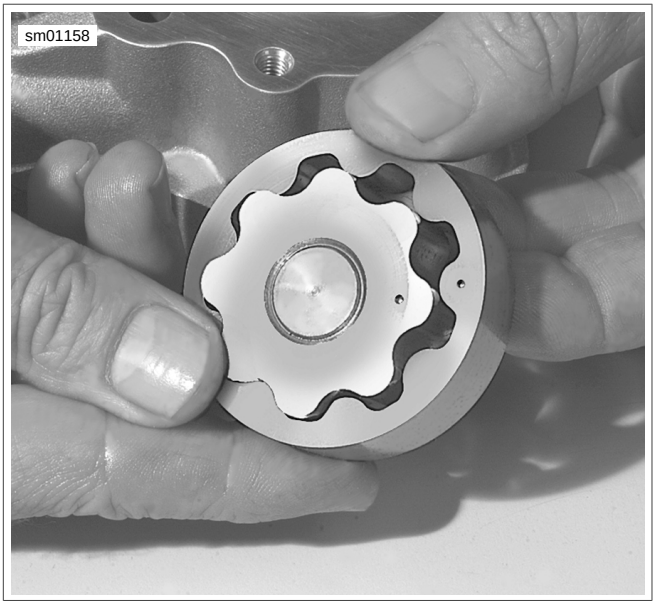



**Figure 3-160. Oil Pump Gerotor**

5. See Figure 3-161. Thoroughly lubricate during assembly. Pack pump housing with Lubriplate No. 105 (NAPA™ Part No. 765-2651) to ensure oil pick-up is immediate.
6. See Figure 3-162. Install new o-rings and lubricate with Harley-Davidson Motorcycle Oil 20W50.
7. See Figure 3-163. Install pump in engine. Tighten three fasteners to 9.7 Nm (86 **in-lbs**) .
8. See Figure 3-164. Using a crisscross pattern, tighten the oil pump cover fasteners to 9.7 Nm (86 **in-lbs**) .
9. Tighten bypass fastener to 35 Nm (25 ft-lbs) .

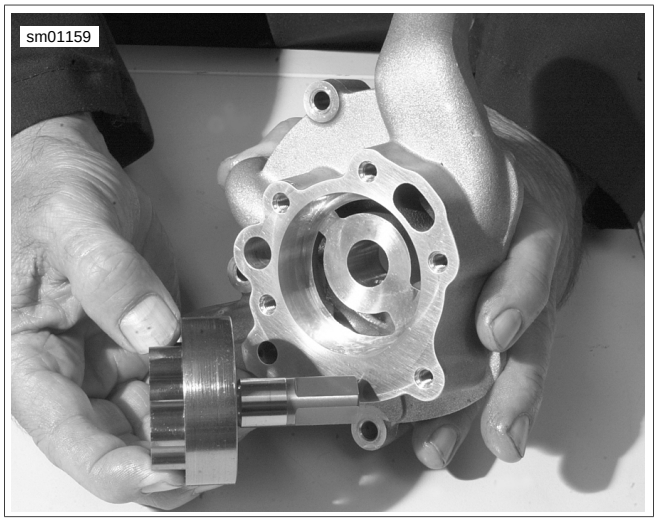



**Figure 3-161. Lubricate Assembly**

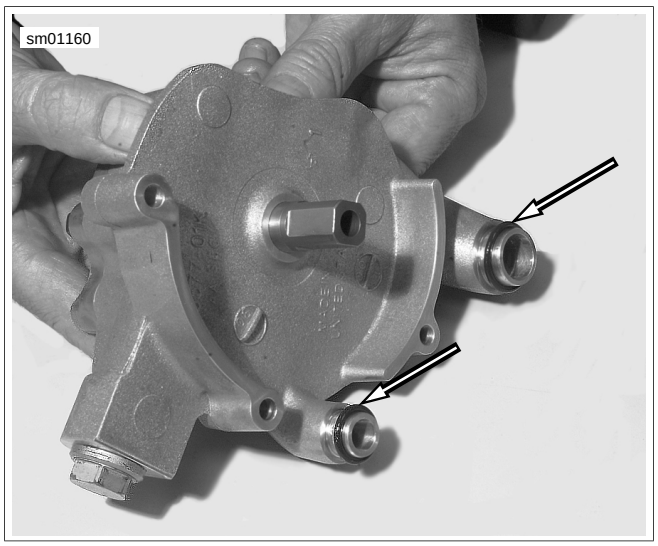



**Figure 3-162. Lubricate O-Rings**

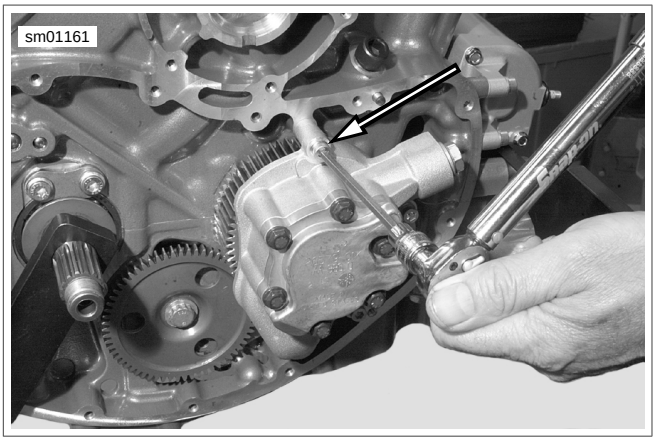



**Figure 3-163. Oil Pump Installation @ 9.7 Nm (in-lbs)**

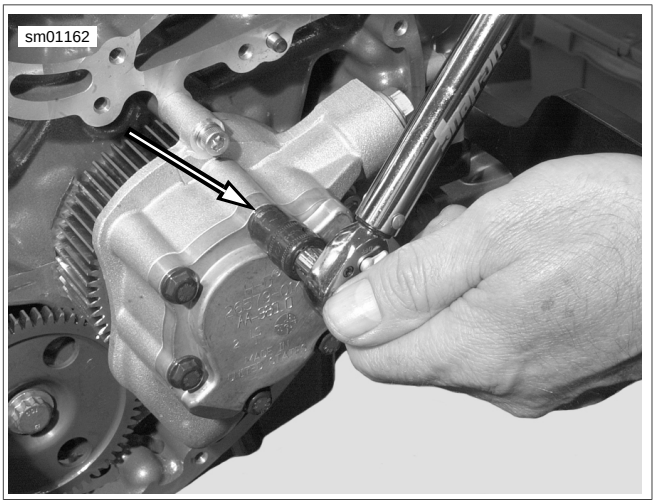



**Figure 3-164. Oil Pump Cover @ 9.7 Nm (in-lbs)**

## REMOVAL/INSTALLATION

1. See Figure 3-165. Remove three fasteners and remove oil filter mount.
2. See Figure 3-166. Remove o-ring and discard.
3. Inspect oil passages for debris and dirt. Clean as required.
4. Install new o-ring and install oil filter mount.

*NOTE*

*Always replace o-ring when oil filter mount has been removed and/or replaced.*

5. Tighten oil filter mount fasteners to 9.7 Nm (86 in-lbs) .

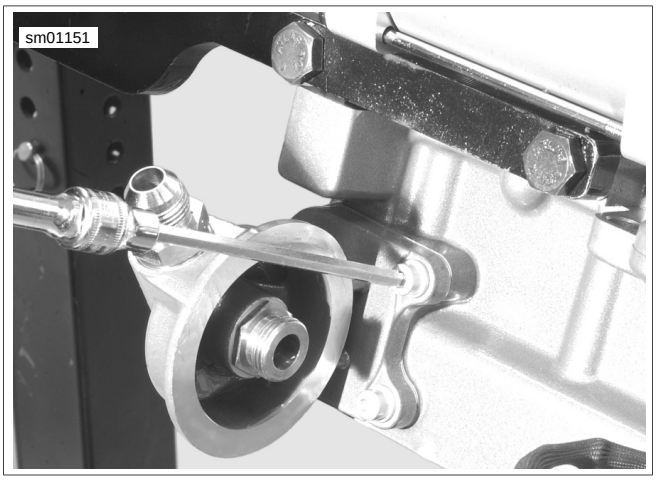



**Figure 3-165. Remove Oil Filter Mount Fasteners**

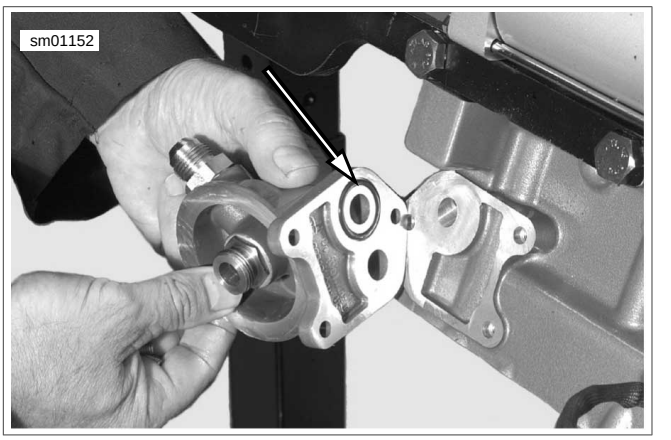



**Figure 3-166. Replace O-Ring**

**SUBJECT** **PAGE NO.**
4.1 SPECIFICATIONS: FUEL SYSTEM....4-1
4.2 ELECTRONIC FUEL INJECTION (EFI)....4-2
4.3 FUEL TANK....4-3
4.4 THROTTLE POSITION SENSOR (TP)....4-5
4.5 INTAKE AIR TEMPERATURE SENSOR (IAT)....4-6
4.6 ENGINE COOLANT TEMPERATURE SENSOR (ECT)....4-8
4.7 THROTTLE BODY AND FUEL RAIL....4-10
4.8 IDLE AIR CONTROL (IAC)....4-13
4.9 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP)....4-14
4.10 OXYGEN SENSOR....4-15
4.11 FUEL INJECTORS....4-18
4.12 FUEL PUMP/FILTER/SENDER ASSEMBLY....4-20
4.13 FUEL PRESSURE TEST....4-25
4.14 EXHAUST SYSTEM: VRSCAW....4-27
4.15 EXHAUST SYSTEM: VRSCD....4-30
4.16 EXHAUST SYSTEM: VRSCDX....4-35
4.17 VAPOR VALVE....4-38
4.18 INTAKE LEAK TEST....4-39
4.19 EVAPORATIVE EMISSIONS CONTROL (CA MODELS)....4-41

# NOTES

## GENERAL

**Table 4-1. Capacities: VRSC Models**

| COMPONENT | METRIC | ENGLISH |
|---|---|---|
| Fuel tank total | 18.9 liters | 5.0 gal |
| Oil sump with filter | 4.7 liters | 5.0 qt |
| Coolant | 2.4 liters | 2.54 qt |
| All VRSC models are shipped with Genuine Harley-Davidson SAE 20W50 Motorcycle oil. | | |

*NOTE*

*The fuse labeled "Security" provides basic turn signal functionality on vehicles without a factory-installed security system. Do not remove this fuse or use it as a replacement fuse for other systems.*

## TROUBLESHOOTING

See the ELECTRICAL DIAGNOSTIC MANUAL for troubleshooting and diagnostic information.

## REMOVAL

**WARNING**

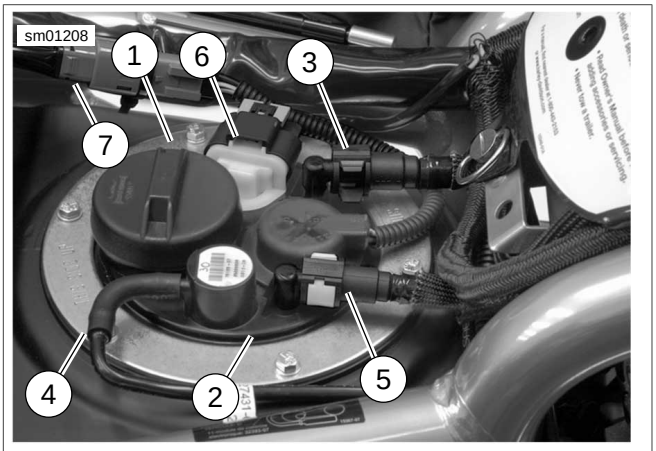
**To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)**

1. Purge fuel supply line of high pressure gasoline.
   a. See Figure 4-1. Disconnect fuel pump and sensor connector (6) [86B] from fuel pump/filter/sensor assembly.
   b. Start engine and allow vehicle to run.
   c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.
2. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
3. Remove airbox. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

4. Disconnect negative battery cable. See 1.9 BATTERY MAINTENANCE.
5. Determine how long before fuel pump/filter/fuel level sensor assembly can be re-installed.
   a. If fuel tank is to be left unattended for any length of time, remove fuel cap and drain fuel tank. Use a pump or siphon and an approved gasoline storage container of sufficient capacity.
   b. If fuel pump/filter/fuel level sensor assembly is to be repaired and reinstalled immediately, open fuel tank can be covered temporarily until fuel pump/filter/fuel level sensor assembly is installed.




1. **Top plate retaining ring**
2. **Top plate**
3. **Pressure fuel line**
4. **Vapor vent hose**
5. **Return fuel line**
6. **Fuel pump connector [86B]**
7. **Fuel sensor connector [13B]**

**Figure 4-1. Fuel Tank Top Plate**

**WARNING**

**Gasoline can drain from the fuel line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00260a)**

6. At fuel rail, disconnect pressure fuel line (3), return fuel line (5) by compressing tabs with thumb and first finger.
7. Disconnect both fuel lines from fuel tank top plate. Pull lines out of path of fuel pump/filter/fuel level sensor assembly.
8. Use opposite thumbs to push the vapor vent hose (4) off of outlet tube.
9. Disconnect fuel pump connector (6), and fuel level sensor connector (7).
10. Check that all components are out of path of fuel pump/filter/fuel level sensor assembly.

*NOTE*

- *Motorcycles not equipped with the H-D Security System will have the siren connector terminated to a cap attached to the wiring harness of the fuel module connector. Pull the siren connector and press the wiring harness out of the way.*
- *Fuel pump/filter/fuel level sensor assembly is lightly spring loaded and will generate a small amount of upward force when fasteners are removed.*

11. Remove six fasteners from top plate retaining ring (1) and remove retaining ring.

**⚠WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**

12. Lift fuel pump/filter/fuel level sensor assembly out of the fuel tank.
13. Cover fuel tank opening or drain fuel tank as required.
14. Remove rear wheel and swingarm. See 2.27 REAR WHEEL and 2.38 SWINGARM.
15. Remove passenger pillion and rear fender.
16. Remove the two fasteners fastening the mud flap plate at rear of voltage regulator. Remove the mud flap by pinching side tabs to disengage from seat pan.
17. Remove fuel cap and fuel filler boot. Replace fuel cap.
18. At the fuel rail, disconnect the larger pressure fuel line and the smaller return fuel line by pressing blue buttons with thumb and first finger. Then disconnect both fuel lines from the fuel tank top plate.
19. Use opposite thumbs to push the vapor vent hose off of the outlet tube.
20. Unbolt the two bolts and their washers on the bracket that holds the fuel tank against the frame.
21. Remove fuel tank from motorcycle.
22. If the fuel tank is going to be stored prior to service, either drain using a siphon or cap the pressure fuel port, the return fuel port, and the vapor vent port on the fuel tank top plate.

## CLEANING AND INSPECTING

1. Drain the fuel tank. Use a common pump or siphon and an approved gasoline storage container of sufficient capacity.
2. Remove fuel pump/filter/fuel level sensor assembly from tank.
3. Clean the tank interior with commercial cleaning solvent or a soap and water solution. Shake the tank to agitate the cleaning agent.
4. Flush the tank thoroughly after cleaning and allow it to air dry.

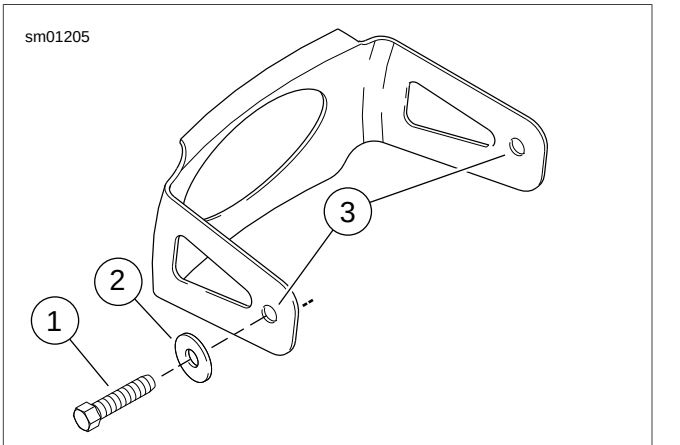
**⚠WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**

5. Inspect the evaporative emissions system vapor valve line and pressure and return fuel lines for cuts, cracks or holes. Replace lines as needed.
6. Inspect the tank for leaks and other damage. If damaged, replace it.

## INSTALLATION

1. Position the fuel tank in the frame and position the fuel tank mounting bracket to the frame.
2. See Figure 4-2. Loosely thread in the two mounting bolts and washers through the forward holes of the bracket into the threaded boss on the frame.
3. Tighten the mounting bolts to 40-48 Nm (30-35 ft-lbs).
4. Connect the fuel module connector while supporting the top plate connector half with the opposite hand.
5. See Figure 4-1. Install the smaller return line and the larger pressure line while supporting the mating port. Press the lines on until the click is heard that indicates engagement.
6. Attach the larger pressure line and the smaller return line to the fuel rail.
7. Press on the vapor vent hose while supporting the mating port with the opposite hand.
8. Install mud flap and stud plate.
9. Install rear fender and passenger pillion.
10. Install swingarm. See 2.38 SWINGARM.
11. Install the rear wheel assembly and adjust the drive belt tension. See 2.27 REAR WHEEL.
12. Fuel the motorcycle as required. Replace the fuel cap.
13. Install airbox. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
14. Connect negative battery cable.
15. Install airbox cover by positioning the airbox cover with the locating pins in the holes on the frame tabs. Turn bailhead fastener 1/4 turn clockwise.
16. Close seat.
17. Install maxi-fuse and the side cover.
18. Check fuel system pressure. See 4.13 FUEL PRESSURE TEST.




1. **Mounting bolt**
2. **Washer**
3. **Hole**

**Figure 4-2. Fuel Tank Mounting Bracket (typical)**

## GENERAL

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the throttle position sensor (TP sensor).

## REMOVAL

1. Remove airbox and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**CAUTION**

**Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)**

2. See Figure 4-3. Cover air intakes (3) to prevent debris from entering cylinders.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

3. Disconnect negative battery cable.
4. Unplug TP sensor connector [88B] (2) by pulling external latch outward and using rocking motion to remove.
5. Remove two screws to detach TP sensor (1) from throttle body. Discard screws.

## INSTALLATION

*NOTES*

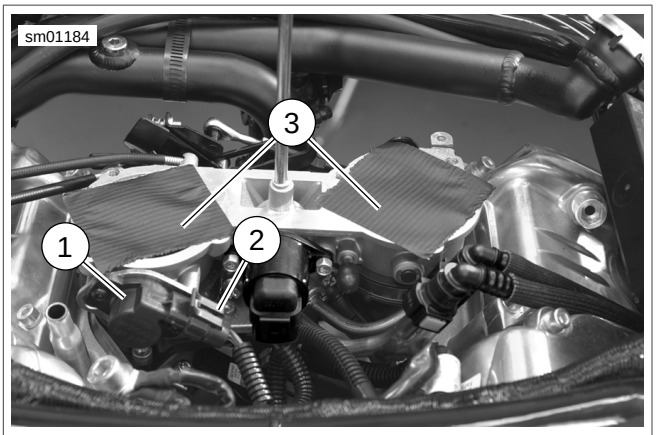
- *Throttle must be closed for proper installation of throttle position sensor.*
- *Throttle position sensor does not have to be adjusted.*

1. See Figure 4-4. With connector facing rear of vehicle, verify that shaft pocket of TP sensor fits over shaft on throttle body.
2. Align holes in TP sensor with holes in throttle body.

*NOTE*

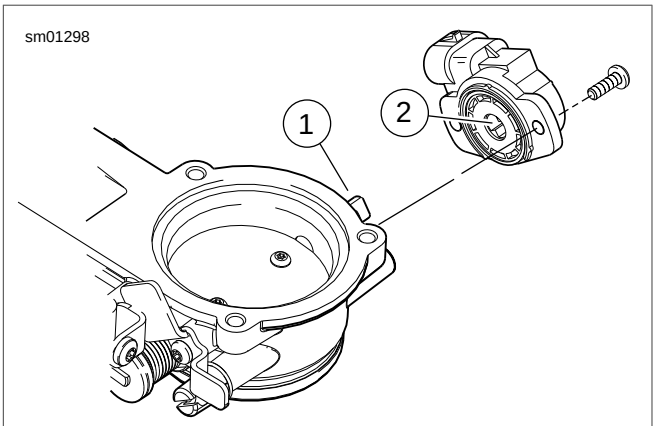
*TP sensor may have to be turned slightly for holes to align.*

3. Install **new** screws and tighten to 2.0-2.8 Nm (18-25 **in-lbs**).
4. See Figure 4-3. Connect TP sensor connector (2).
5. Connect negative battery cable.
6. Install airbox and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.




**1. Throttle position sensor (TP sensor)**
**2. TP sensor connector [88B]**
**3. Air intakes (covered)**

**Figure 4-3. Throttle Position Sensor**




**1. Shaft**
**2. Shaft pocket**

**Figure 4-4. Throttle Position Sensor Installation**

## GENERAL

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the intake air temperature sensor (IAT sensor).

## REMOVAL

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
3. See Figure 4-5. Remove IAT sensor connector [89B].
   a. See Figure 4-6. Depress wire form.
   b. Use rocking motion to detach connector from IAT.
4. See Figure 4-7. Depress the retaining fingers (2) on the under side of IAT sensor and pull IAT sensor from upper airbox.

*NOTE*

*A short length of tubing with an ID of 7.62 mm (0.312 in) can be pushed over the retaining fingers to ease the sensor removal.*

## INSTALLATION

1. See Figure 4-7. Inspect IAT o-ring (1). Replace IAT sensor if o-ring is worn or damaged.
2. Apply **clean** engine oil to IAT sensor o-ring.
3. Install IAT sensor into upper airbox.
4. Connect IAT sensor connector [89B].
5. Install airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
6. Install the maxi-fuse.
7. Install right side cover.

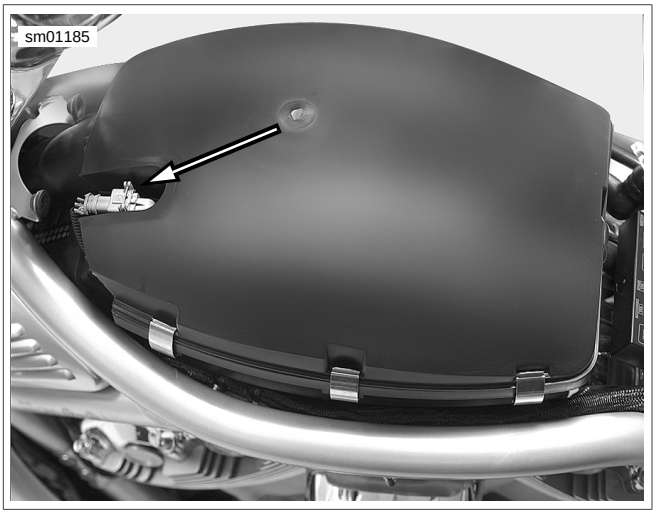



**Figure 4-5. Intake Air Temperature Sensor Location (typical)**

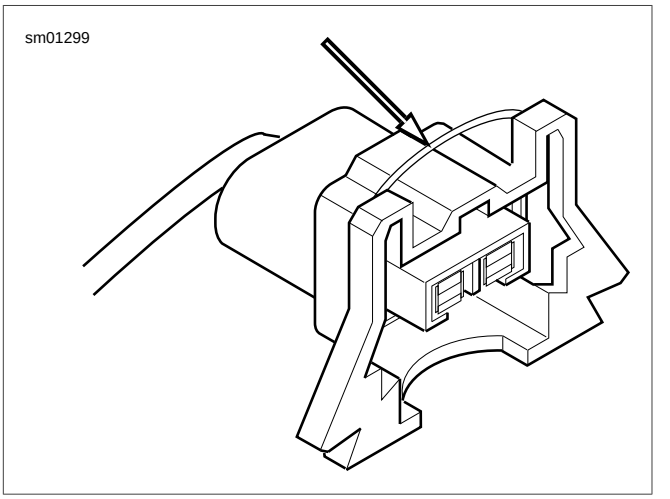
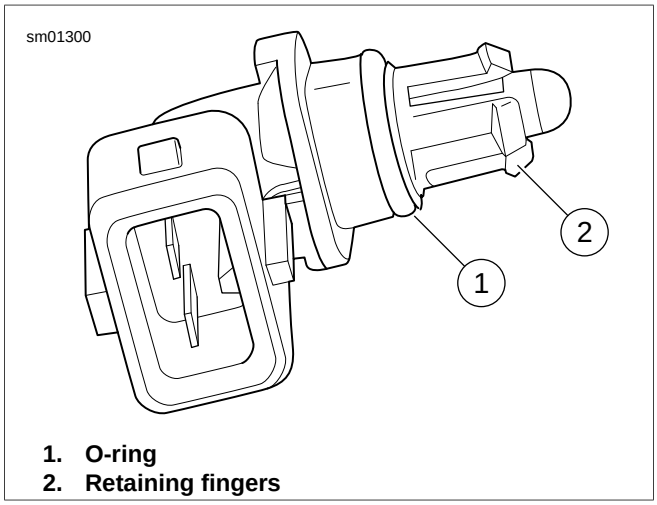



**Figure 4-6. IAT Connector Wire Form**




1. **O-ring**
2. **Retaining fingers**

**Figure 4-7. IAT Sensor**

# ENGINE COOLANT TEMPERATURE SENSOR (ECT) 4.6

## GENERAL

Refer to ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the engine coolant temperature (ECT) sensor.

## REMOVAL

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove airbox assembly. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**CAUTION**

**Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)**

3. Cover air intakes to prevent debris from entering cylinders.
4. Remove block drain screw. Drain cooling system. See 6.3 ENGINE COOLANT.
5. Loosen clamps at each intake and lift throttle body straight up.

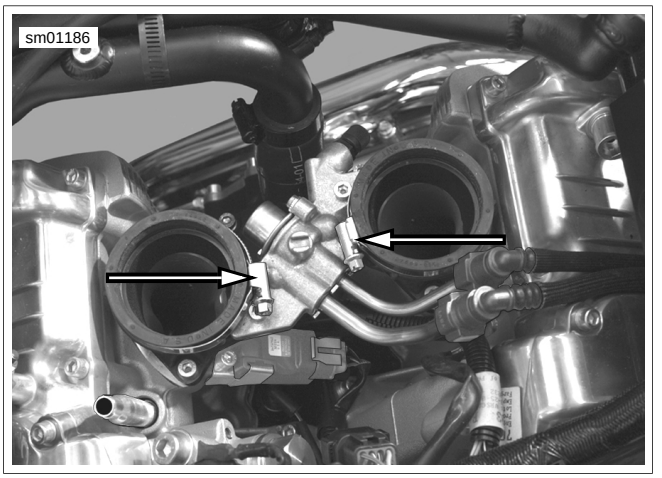



**Figure 4-8. Intake Clamps, Throttle Body Removed (typical)**

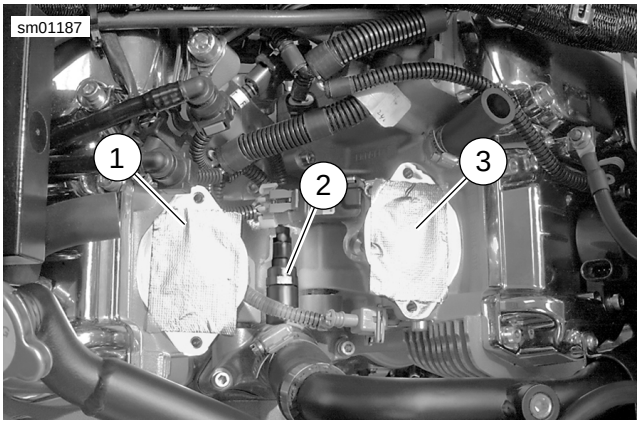
*NOTE*

*Note position of the clamps for reassembly.*

6. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine.
7. Cover intake openings to prevent objects from falling into intake bore. Remove throttle body and fuel rail.
8. See Figure 4-9. Unplug ECT sensor connector [90B] by pulling external latch outward and using rocking motion to remove.
9. Loosen ECT sensor using socket. When sensor starts to turn easily, finish removing by hand.

## INSTALLATION

1. Hand start **new** ECT sensor into thermostat housing 2-3 turns.
2. Tighten sensor to 23 Nm (17 ft-lbs).
3. Connect ECT sensor connector [90B].
4. Uncover intake openings and throttle body.
5. Orient intake clamps as shown and install throttle body and fuel rail. Tighten clamps 1.25 Nm (11 **in-lbs**).
6. Install coils. See 1.22 SPARK PLUGS AND COIL.
7. Attach fuel lines.
   a. Insert fuel lines from injector back under frame and connect to fuel tank.
   b. Push connector onto fuel tank elbow until a "click" is heard.
   c. Install right angle connectors on rigid lines from injector. Push until audible "click" is heard.
8. Fill engine coolant system with Genuine Harley-Davidson Extended Life Antifreeze & Coolant through the coolant overflow bottle.
9. Replace the maxi-fuse and right side cover.
10. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
11. Continue to run engine, check level, and add antifreeze until coolant level remains at COLD FULL line with the motorcycle on the jiffy stand.




1. **Front intake**
2. **ECT**
3. **Rear intake**

**Figure 4-9. ECT Sensor Location (typical)**

## REMOVAL

1. Disconnect the idle speed control (IAC) connector.
2. DIsconnect the throttle position (TP) sensor.
3. See Figure 4-10. Loosen throttle body clamps.
4. Detach throttle body from rubber seals by pulling up with a gentle rocking motion. If engine is in chassis, it is not necessary to disconnect throttle cables. Move throttle body and cables aside and secure away from engine.
5. See Figure 4-11. Remove fuel rail/intake seal fasteners. Bottom nut is captured but should be held with a wrench for removal.
6. See Figure 4-12. Without disturbing the fuel rail, rotate rubber seal from under fuel rail.
7. Remove fastener holding the MAP sensor. Separate connector [80].
8. See Figure 4-14. Pull front injector from front intake runner.
9. With front injector free, swing fuel rail toward cam drive side and pull rear injector from rear intake runner.
10. See Figure 4-13. Unplug connector [84], front injector and connector [85], rear injector.
11. Unplug engine coolant temperature sensor connector [90] and oil pressure sending unit connector [120].
12. Unplug engine harness at connector [145].
13. Disassemble and service fuel rail and fuel injectors.

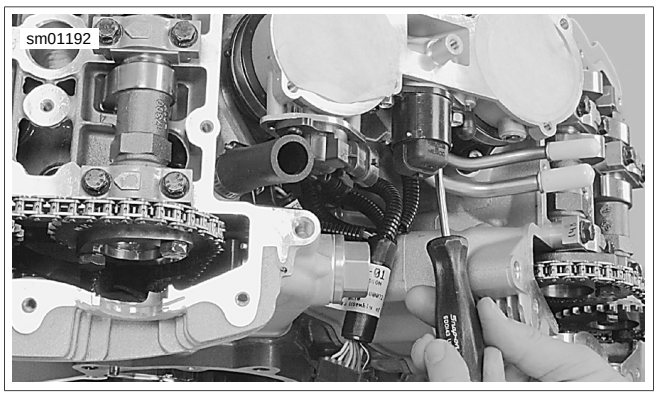



**Figure 4-10. Loosen Throttle Body Clamps (typical)**




**Figure 4-11. Fuel Rail/intake Seal Fasteners (typical)**




**Figure 4-12. Rubber Seal**

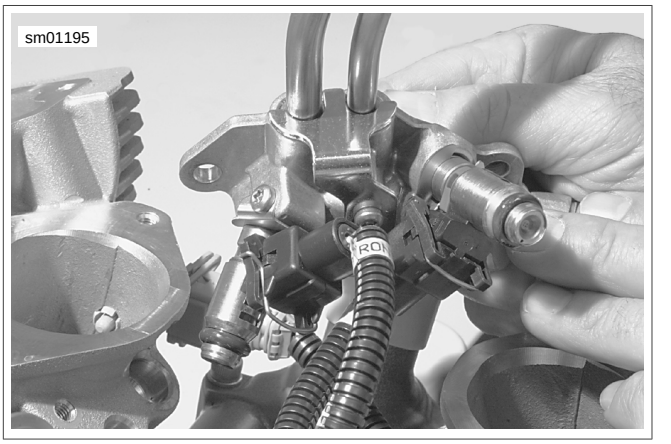



**Figure 4-13. Fuel Rail with Injectors**

## INSTALLATION

1. Assemble fuel rail.
2. Install fuel injectors. See 4.11 FUEL INJECTORS.
3. Connect engine harness at connector [145].

4. Connect engine coolant temperature sensor connector [90] and oil pressure sending unit connector [120].
5. See Figure 4-13. Connect connector [84], front injector and connector [85], rear injector on fuel rail.
6. Supporting fuel rail oriented with fuel tubes toward the left rear, push rear injector into bore in intake runner.
7. Swing fuel rail over and push front injector into intake runner in front cylinder.
8. Rotate rubber boots under fuel rail and install rubber boots over intake runners.
9. Install fasteners through fuel rail into rubber boots. Tighten to 9.7 Nm (86 **in-lbs**).
10. See Figure 4-15. Orient intake clamps as shown.
11. Press throttle body and cables into rubber boots.
12. See Figure 4-16. Tighten intake hose clamps (7) to 1.25 Nm (11 **in-lbs**).
13. See 1.22 SPARK PLUGS AND COIL. Install spark plugs and coils. Tighten to:
    a. Tighten spark plugs to 23 Nm (17 ft-lbs).
    b. Tighten coil fasteners to 9.7 Nm (86 **in-lbs**).
14. Attach the idle speed control (IAC) connector.
15. Attach the throttle position (TP) sensor.
16. Install right angle connectors on rigid fuel lines from fuel rail. Push until audible "click" is heard.

*NOTE*

*It may be helpful to remove thermostat hose and install front cylinder first, then rear cylinder during this procedure.*

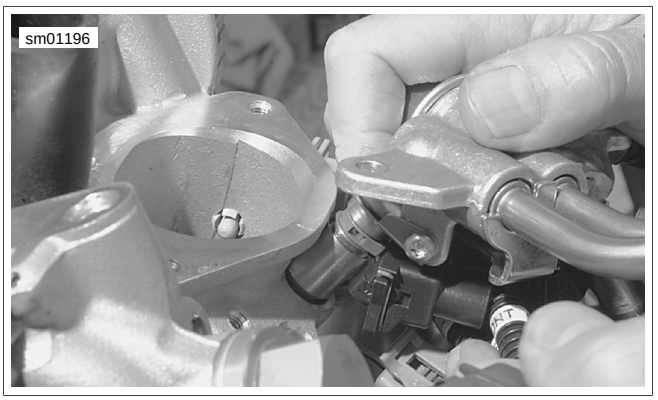



**Figure 4-14. Front Injector**

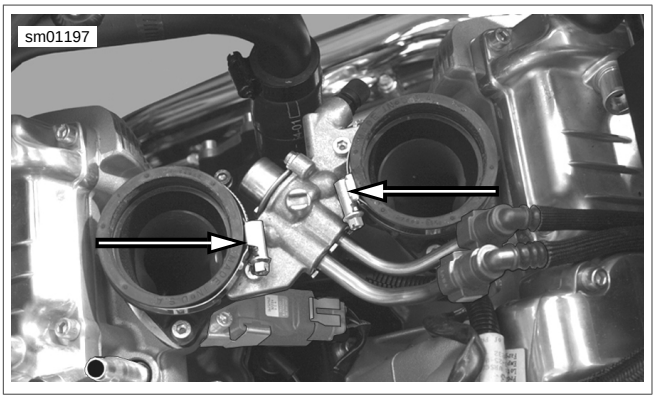
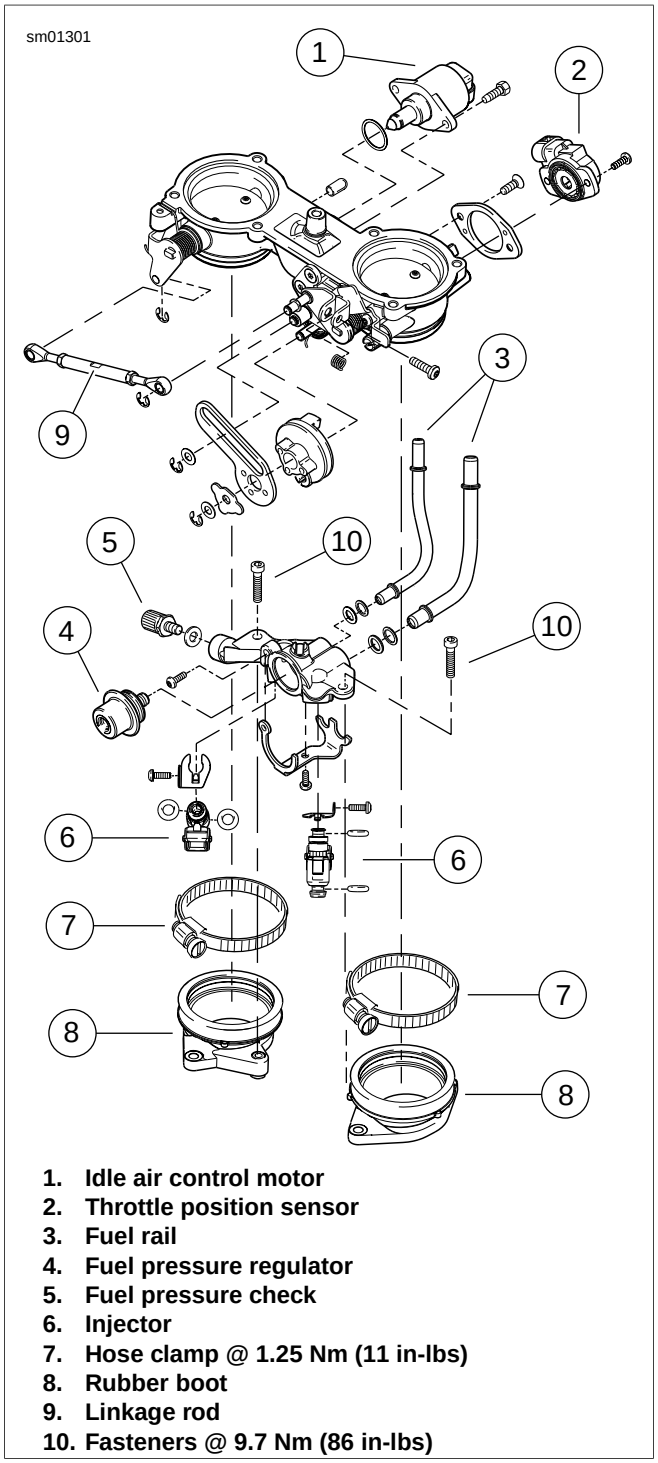



**Figure 4-15. Throttle Body Intake Clamps**




1. **Idle air control motor**
2. **Throttle position sensor**
3. **Fuel rail**
4. **Fuel pressure regulator**
5. **Fuel pressure check**
6. **Injector**
7. **Hose clamp @ 1.25 Nm (11 in-lbs)**
8. **Rubber boot**
9. **Linkage rod**
10. **Fasteners @ 9.7 Nm (86 in-lbs)**

**Figure 4-16. Throttle Body and Fuel Rail**

## GENERAL

**WARNING**

**Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)**

Refer to the ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the idle air control (IAC).

## REMOVAL

**WARNING**

**If a heat gun is required to remove screws that attach idle control flange to induction module, remove module before proceeding. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00270a)**

1. Remove airbox and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**CAUTION**

**Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)**

2. See Figure 4-17. Cover air intakes (3) to prevent debris from entering cylinders.

**WARNING**

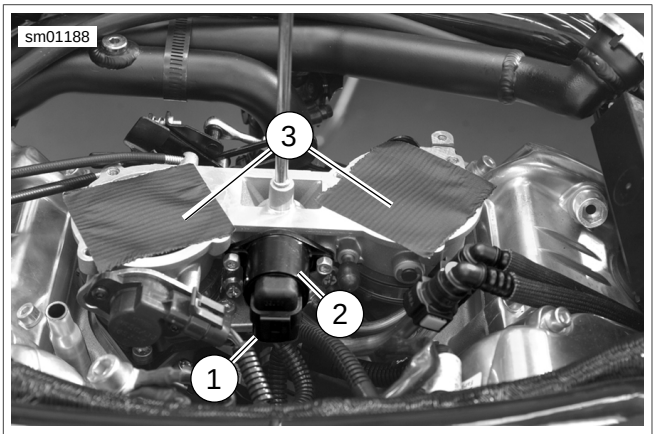
**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

3. Disconnect negative battery cable.
4. Remove throttle body. See 4.7 THROTTLE BODY AND FUEL RAIL.
5. Disconnect throttle cables from throttle body.

*NOTE*

*Do not apply excessive heat to idle air control. Apply only enough heat to break LOCTITE® patch on screws. Excessive heat will cause damage to idle air control.*

6. See Figure 4-18. Using heat gun, apply heat to idle air control screws (2) to break LOCTITE® patch. Remove screws.
7. Pull IAC (1) and o-ring from throttle body (3).

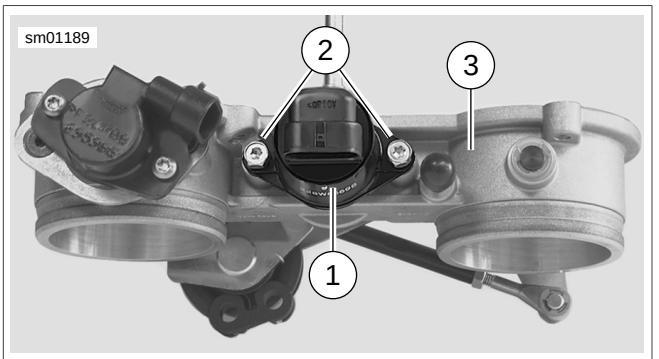



1. **IAC sensor connector [87B]**
2. **Idle air control (IAC)**
3. **Air intakes (covered)**

**Figure 4-17. IAC Sensor (typical)**

## INSTALLATION

1. Inspect IAC o-ring, replace if damaged.
2. Apply **clean** engine oil to IAC o-ring.
3. Place idle air control and o-ring into throttle body. Be sure o-ring is properly seated in throttle body groove.
4. See Figure 4-18. Apply LOCTITE® Treadlocker 243 (blue) to screws (2). Loosely install front and rear IAC screws (2).
5. Tighten front and rear IAC screws to 2-4 Nm (25-35 **in-lbs**).
6. Connect throttle cables to throttle body.
7. Install throttle body. See 4.7 THROTTLE BODY AND FUEL RAIL.
8. Connect negative battery cable.
9. Install airbox and air filter. See 1.8 ENGINE OIL AND FILTER.




1. **IAC**
2. **Screws**
3. **Throttle body**

**Figure 4-18. IAC Removal**

# MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP) 4.9

## REMOVAL

1. Remove airbox and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**CAUTION**

**Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)**

2. Cover air intakes to prevent debris from entering cylinders.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

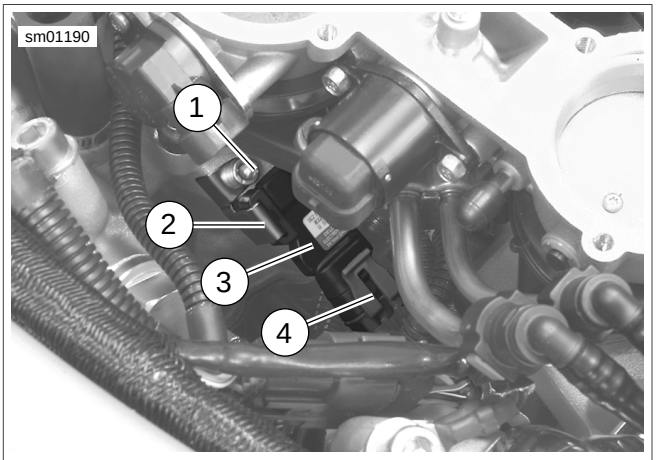
3. Disconnect negative battery cable.
4. See Figure 4-19. Remove bolt (1) securing MAP sensor bracket (2) to front cylinder.
5. Unplug MAP sensor connector [80B] (4) by pulling external latch outward and using rocking motion to remove.

*NOTE*

*If the original sensor is installed, the grommet must be inspected. Grommets not in good condition could cause vacuum leaks.*

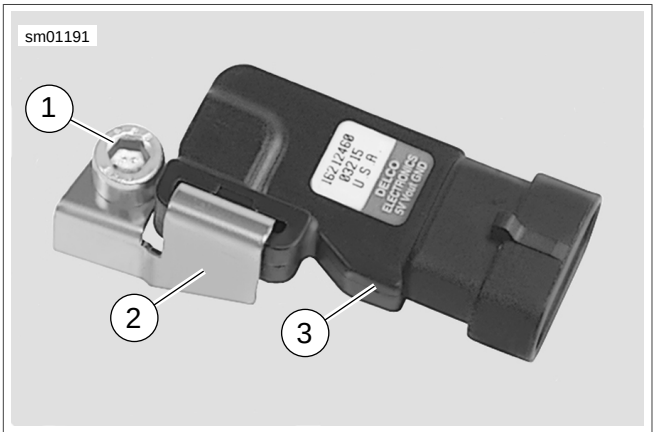
## INSTALLATION

1. Plug connector into MAP sensor.
2. See Figure 4-20. Install bracket (2) over MAP sensor (3).
3. Install (push) MAP sensor and grommet to intake manifold.
4. Secure MAP sensor bracket with bolt. Tighten bolt to 6.0-10.0 Nm (53.0-88 **in-lbs**).
5. Connect negative battery cable.
6. Install airbox and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.




1. **Bolt**
2. **Bracket**
3. **MAP sensor**
4. **Connector [80B]**

**Figure 4-19. MAP Sensor Location (typical)**




1. **Bolt**
2. **Bracket**
3. **MAP sensor**

**Figure 4-20. MAP Sensor**

## OXYGEN SENSOR

### Front Sensor Removal

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. See 8.4 MAXI-FUSE. Remove Maxi-Fuse.
2. Remove left-side radiator cover. See 1.6 RADIATOR SIDE COVERS.
3. Note routing of sensor cable from oxygen sensor. See Figure 4-21.
4. See Figure 4-22. Locate and disconnect sensor connector from wiring harness and remove cable from position.
5. Remove oxygen sensor from front header. See Figure 4-23.

### Rear Sensor Removal

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. See 8.4 MAXI-FUSE. Remove Maxi-Fuse.
2. See Figure 4-21. Note routing of sensor cable from oxygen sensor.
3. See Figure 4-22. Locate and disconnect sensor connector under seat, and remove cable from position.
4. See Figure 4-24. Remove oxygen sensor heat shield/bracket located behind rear cylinder head.
5. See Figure 4-25. Remove oxygen sensor from rear header.




**Figure 4-21. Oxygen Sensor (typical)**

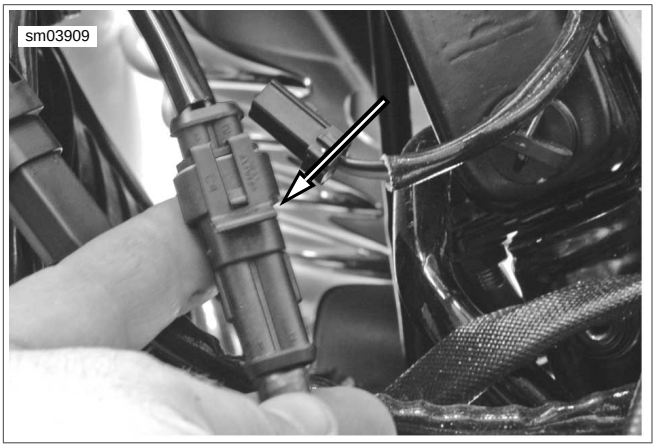



**Figure 4-22. Oxygen Sensor Connector (typical)**

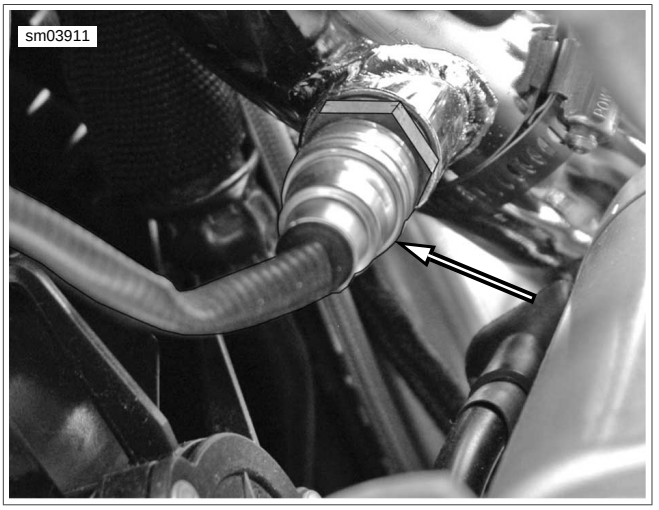



**Figure 4-23. Front Oxygen Sensor**

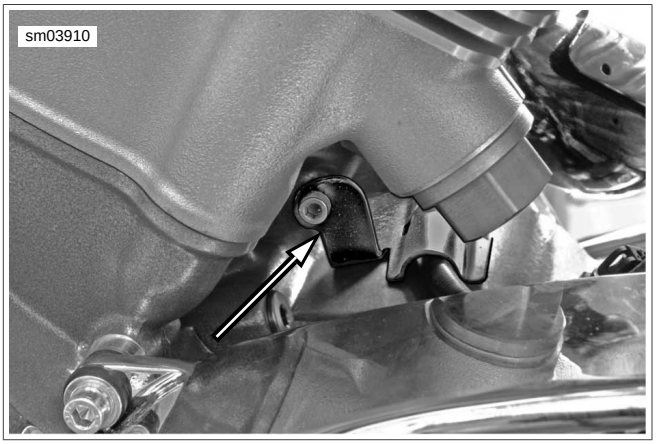



**Figure 4-24. Oxygen Sensor Heat Shield/Bracket**

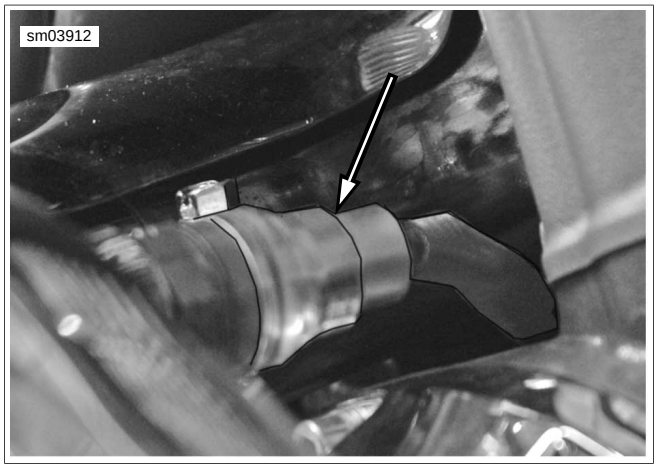



**Figure 4-25. Rear Oxygen Sensor**

## OXYGEN SENSOR

### Front Sensor Installation

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

*NOTES*

- *Do not install sensors that have been dropped or impacted by other components. Damage to the sensing element may have occurred. Replacement sensor assemblies have threads coated with anti-seize lubricant and **new** seal rings.*
- *Apply a thin coat of LOCTITE ANTI-SEIZE (Part No. 98960-97) to threads of each oxygen sensor prior to installing in header. Do not use any other grease or sealant product on sensor threads. The electrical connector must also be clean and free of any dielectric grease.*

1. See Figure 4-30. If installing original oxygen sensor instead of a new sensor, apply a thin coat of anti-seize (Part No. 98960-97) to thread of oxygen sensor, using caution not to get anti-seize on sensor ceramic at tip of sensor.
2. Thread oxygen sensor into header by hand until snug.
3. Route oxygen sensor cable as it was originally routed from the factory. Replace any cable ties removed when removing old sensor.
4. See Figure 4-27. Locate and connect sensor connector to wiring harness.
5. Final tighten oxygen sensor to 40-60 Nm (29-44 ft-lbs).

### Rear Sensor Installation

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

*NOTES*

- *Do not install sensors that have been dropped or impacted by other components. Damage to the sensing element may have occurred. Replacement sensor assemblies have threads coated with anti-seize lubricant and **new** seal rings.*
- *Apply a thin coat of LOCTITE ANTI-SEIZE (Part No. 98960-97) to threads of each oxygen sensor prior to installing in header. Do not use any other grease or sealant product on sensor threads. The electrical connector must also be clean and free of any dielectric grease.*

1. See Figure 4-30. If installing original oxygen sensor instead of a new sensor, apply a thin coat of anti-seize (Part No. 98960-97) to thread of oxygen sensor, using caution not to get anti-seize on sensor ceramic at tip of sensor.
2. See Figure 4-30. Thread oxygen sensor into header by hand until snug.
3. Route oxygen sensor cable as it was originally routed from the factory. Replace any cable ties removed when removing old sensor.
4. See Figure 4-27. Locate and connect sensor connector to wiring harness.
5. Final tighten oxygen sensor to 40-60 Nm (29-44 ft-lbs).
6. See Figure 4-27. Install oxygen sensor heat shield bracket. Tighten fastener to 8-12 Nm (71-106 **in-lbs**).




**Figure 4-26. Oxygen Sensor (typical)**

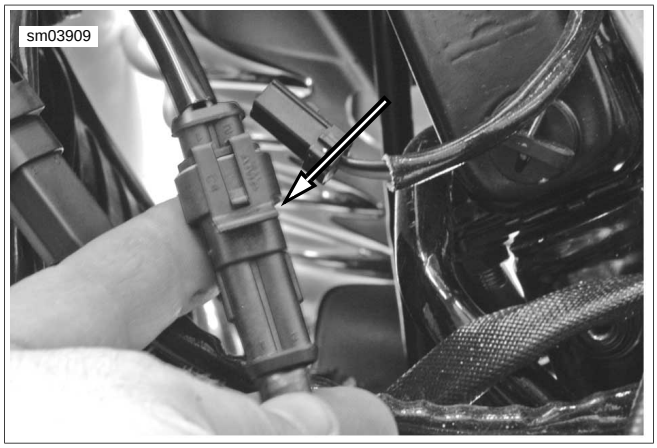



**Figure 4-27. Oxygen Sensor Connector (typical)**

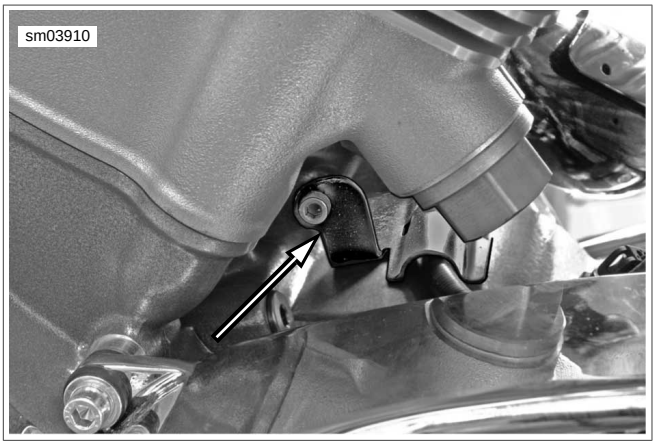



**Figure 4-29. Oxygen Sensor Heat Shield/Bracket**

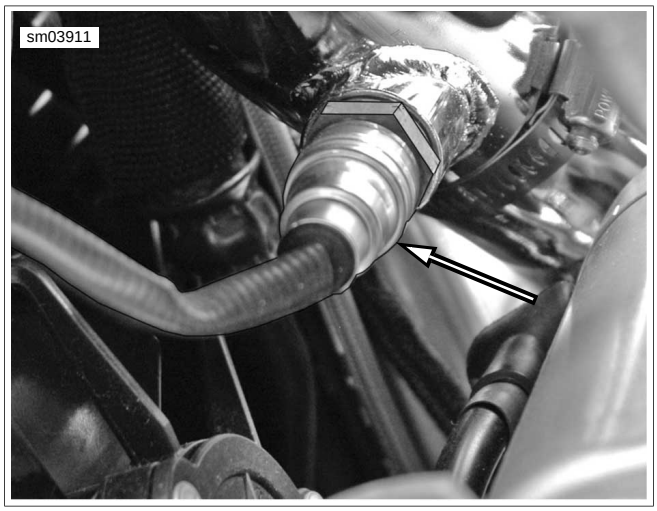



**Figure 4-28. Front Oxygen Sensor**

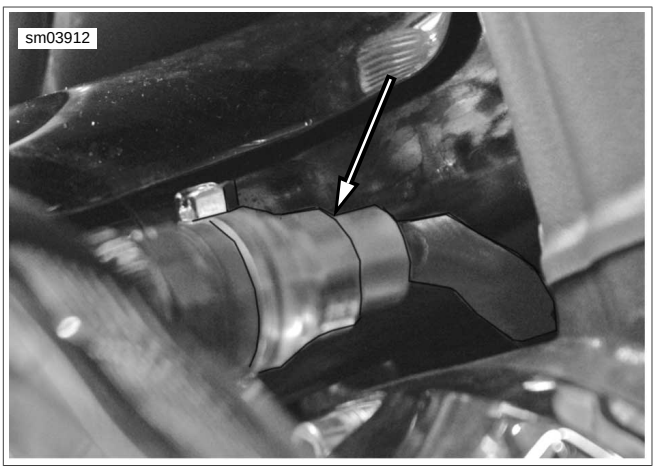



**Figure 4-30. Rear Oxygen Sensor**

## GENERAL

**WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**

Refer to ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the fuel injectors.

## REMOVAL

1. Remove airbox and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

2. Disconnect negative battery cable.
3. Loosen clamps at each intake and lift throttle body straight up.

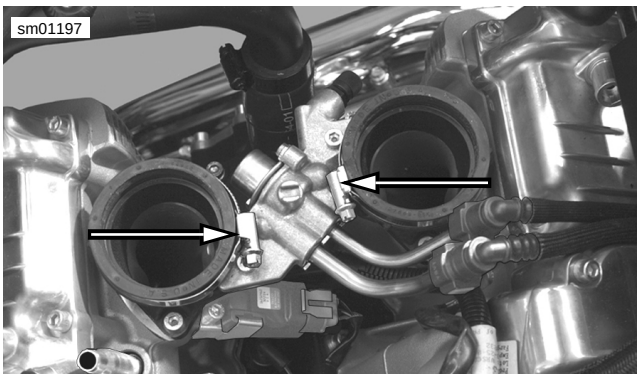



**Figure 4-31. Throttle Body Intake Clamps**

*NOTE*

*Observe the position of the clamps for reassembly.*

4. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine. See 4.7 THROTTLE BODY AND FUEL RAIL.

## DISASSEMBLY

### Fuel Injectors

1. See Figure 4-32. Remove screw (7).
2. Pull fuel injector and clip from induction module.
3. Remove clip from fuel injector.
4. Repeat procedure for other fuel injector.

### Fuel Pressure Regulator

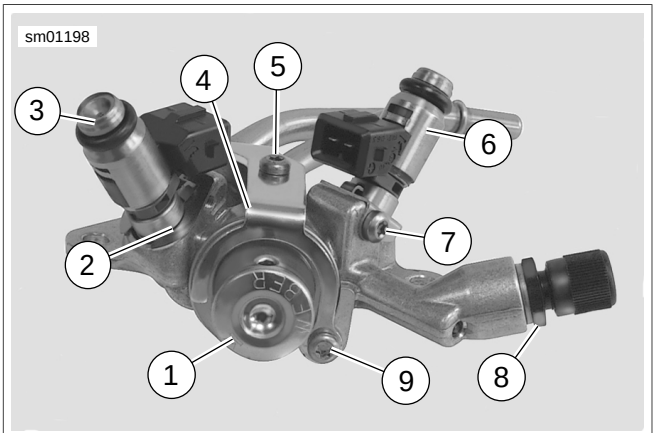
1. See Figure 4-32. Remove screws (5, 9).
2. Remove fuel pressure regulator clip (4) from fuel rail.
3. Use rocking motion to detach fuel pressure regulator (1) from fuel rail.

### Fuel Tubes

*NOTE*

*Do not remove fuel tubes, o-rings or spacers if not replacing.*

1. See Figure 4-32. Remove screws (5, 9).
2. Remove fuel pressure regulator clip (4) from fuel rail.
3. See Figure 4-33. Pull feed (4) and return (5) fuel tubes from fuel rail.




1. **Fuel pressure regulator**
2. **Fuel injector clip**
3. **Front fuel injector**
4. **Fuel pressure regulator clip**
5. **Screw**
6. **Rear fuel injector**
7. **Screw**
8. **Schrader valve 6.8-9.6 Nm (60.0-85.0 in-lbs)**
9. **Screw**

**Figure 4-32. Fuel Rail**

## ASSEMBLY

### Fuel Injectors

1. Inspect fuel injector o-rings, replace if damaged
2. Apply **clean** engine oil to fuel injector o-rings.
3. Insert fuel injector into fuel rail.
4. Slide fuel injector clip into slot in fuel injector.
5. Secure with screw and tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).
6. Repeat for other fuel injector.

### Fuel Pressure Regulator

1. Inspect fuel pressure regulator o-rings. Replace pressure regulator if o-rings are damaged.
2. Apply **clean** engine oil to fuel pressure regulator o-rings.

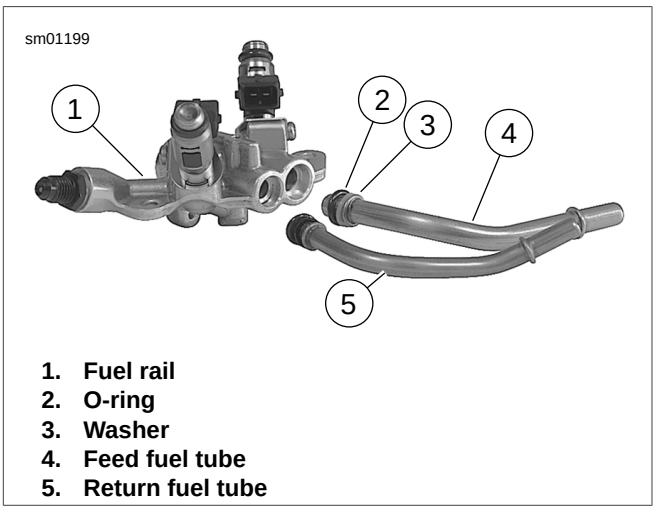
3. Install fuel pressure regulator into bore in fuel rail.
4. See Figure 4-32. Install fuel pressure regulator clip over fuel tubes.
5. Install screws (5, 9). Tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).

## Fuel Tubes

1. See Figure 4-33. Install washers (3) over fuel tube.
2. Apply **clean** engine oil to **new** fuel tube o-rings (2).
3. Install feed and return fuel tubes into proper holes in fuel rail.
4. See Figure 4-32. Install fuel pressure regulator clip over fuel tubes.
5. Install screws (5, 9). Tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).

## INSTALLATION

1. Install fuel rail and throttle body. See 4.7 THROTTLE BODY AND FUEL RAIL.
2. Connect negative battery cable.
3. Install airbox and filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.




1. **Fuel rail**
2. **O-ring**
3. **Washer**
4. **Feed fuel tube**
5. **Return fuel tube**

**Figure 4-33. Fuel Tubes**

## REMOVAL

1. Open seat.

**⚠WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**

**⚠WARNING**

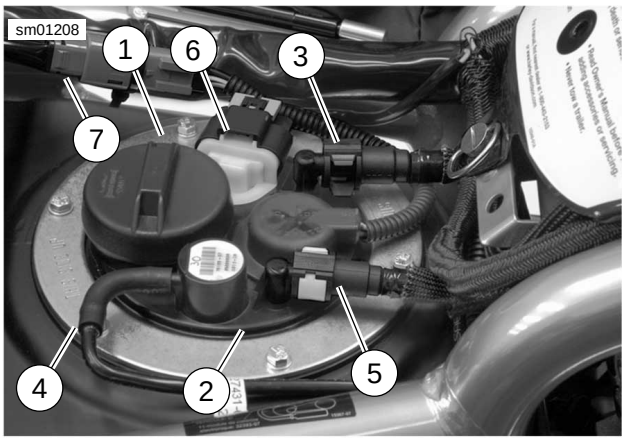
**To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)**

2. Purge fuel supply line of high pressure gasoline.
   a. See Figure 4-34. Disconnect fuel pump connector (6) [86B] from fuel tank top plate.
   b. Start engine and allow vehicle to run.
   c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.
3. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
4. Remove airbox. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

5. Disconnect negative battery cable. See 1.9 BATTERY MAINTENANCE.
6. Determine how long before fuel pump/filter/fuel level sensor assembly can be re-installed.
   a. If fuel tank is to be left unattended for any length of time, remove fuel cap and drain fuel tank. Use a pump or siphon and an approved gasoline storage container of sufficient capacity.
   b. If fuel pump/filter/fuel level sensor assembly is to be repaired and reinstalled immediately, open fuel tank can be covered temporarily until fuel pump/filter/fuel level sensor assembly is installed.




1. **Top plate retaining ring**
2. **Top plate**
3. **Pressure fuel line**
4. **Vapor vent hose**
5. **Return fuel line**
6. **Fuel pump connector [86B]**
7. **Fuel sensor connector [13B]**

**Figure 4-34. Fuel Tank Top Plate**

**⚠WARNING**

**Gasoline can drain from the fuel line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00260a)**

7. At fuel rail, disconnect pressure fuel line (3), return fuel line (5) by compressing tabs with thumb and first finger.
8. Disconnect both fuel lines from fuel tank top plate. Pull lines out of path of fuel pump/filter/fuel level sensor assembly.
9. Use opposite thumbs to push the vapor vent hose (4) off of outlet tube.
10. Disconnect fuel pump connector (6), and fuel level sensor connector (7).
11. Check that all components are out of path of fuel pump/filter/fuel level sensor assembly.

*NOTE*

- *Motorcycles not equipped with the H-D Security System will have the siren connector terminated to a cap attached to the wiring harness of the fuel module connector. Pull the siren connector and press the wiring harness out of the way.*
- *Fuel pump/filter/fuel level sensor assembly is lightly spring loaded and will generate a small amount of upward force when fasteners are removed.*

12. See Figure 4-34. Remove six fasteners from top plate retaining ring (1) and remove retaining ring.

**⚠WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**

13. Lift fuel pump/filter/fuel level sensor assembly out of the fuel tank.
14. Cover fuel tank opening or drain fuel tank as required.

## INSTALLATION

1. See Figure 4-35. Apply a small dab of silicone gasket sealer to **new** fuel tank top plate o-ring. Install quad seal onto shoulder of tank opening. Let gasket sealer cure for five minutes.

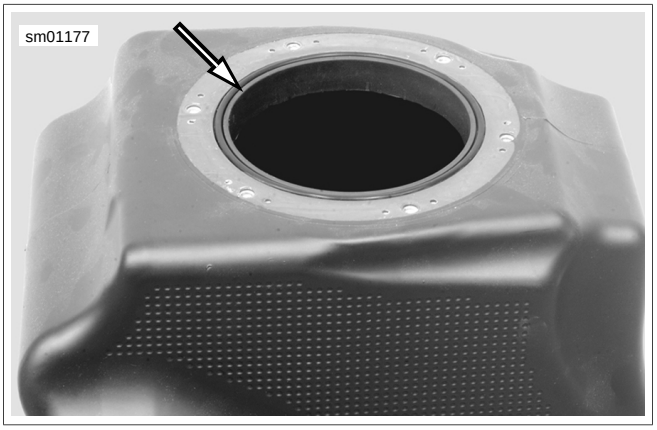



**Figure 4-35. Fuel Tank O-ring (typical)**

*NOTE*

*Fuel pump/filter/fuel level sensor assembly is lightly spring loaded and requires a small amount of downward force when installing. Be sure not to pinch hoses when compressing assembly as this will obstruct fuel flow.*

2. Insert fuel pump/filter/fuel level sensor assembly into fuel tank. Allow top plate to fall into position and rubber spacer/bumper on bottom of fuel pump/filter/fuel level sensor assembly to rest on bottom of fuel tank.

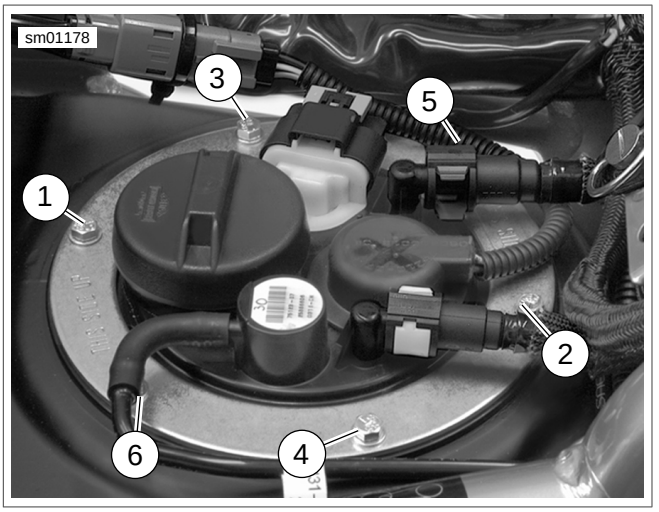



**Figure 4-36. Torque Sequence**

3. See Figure 4-36. Install top plate retaining ring and fasteners. Tighten to 5-6 Nm (44-53 **in-lbs**).
4. See Figure 4-34. Mate fuel pump connector half (6), and fuel level sensor connector (7) while supporting the top plate connector half with opposite hand.

*NOTE*

*To avoid bending connector pins, gently press connectors parallel or straight into pin module connectors.*

5. See Figure 4-34. Install return fuel line and larger pressure fuel line while supporting mating port. Press lines on until and audible click is heard that indicates engagement.

*NOTE*

*Be sure to connect fuel lines to correct ports and verify fuel lines are properly installed before starting vehicle. Failure to connect fuel lines properly can result in a spray of gasoline when ignition switch is turned on. Gasoline is extremely flammable and explosive which could result in death or serious injury.*

6. Press on fuel vapor vent hose while supporting mating port.

**⚠WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**

7. Connect negative battery cable. See 1.9 BATTERY MAINTENANCE.
8. Install airbox. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
9. Close seat.
10. Replace the maxi-fuse and right side cover.
11. Check fuel system pressure. See 4.13 FUEL PRESSURE TEST.

## SUCTION SIDE FUEL FILTER

**⚠WARNING**

**Gasoline can drain from components when disconnected from fuel pump/filters/fuel level sender assembly. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00273a)**

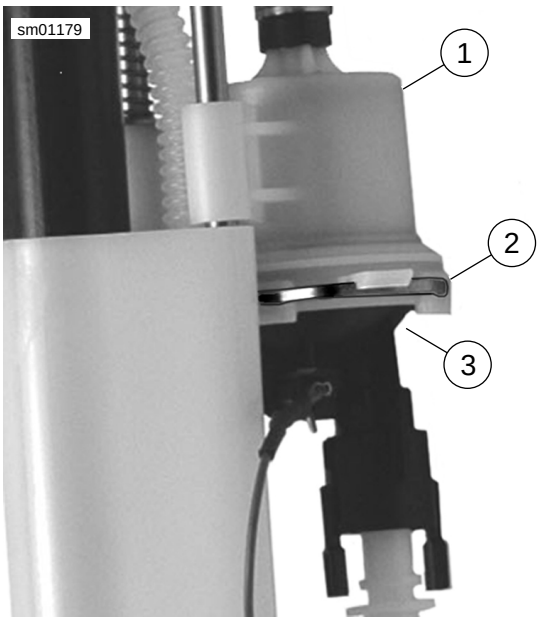
See Figure 4-38. The suction side filter filters the fuel as it enters the strained intake of the fuel pump. The suction side filter is replaced at the service interval of 161,000 kilometers (100,000 miles).

## PRESSURE SIDE FUEL FILTER

See Figure 4-37. The pressure side filter filters the fuel before it enters the pressure fuel line. The pressure side filter is serviced at a service interval of 40,233 kilometers (25,000 miles) or any time the fuel pump is serviced.

### Removal

1. See Figure 4-37. To remove, slide clip (2) outward.
2. Disconnect base (3) from fuel filter canister (1).
3. Pull fuel o-ring and filter from fuel filter canister.




1. **Fuel filter canister**
2. **Fuel filter canister clip**
3. **Fuel filter base**

**Figure 4-37. Pressure Side Filter**

### Installation

1. Insert a **new** pressure side filter and o-ring into fuel filter canister (1).
2. Install fuel filter base (3).
3. Slide fuel filter canister clip into place until an audible click is heard (2).

## FUEL PUMP

### General

The fuel pump pumps fuel from the tank sump and provides filtered, pressurized fuel to the fuel rail. The fuel rail pressure is controlled by a pressure regulator. The injectors receive fuel directly from the fuel rail. The bypass fuel from the pressure regulator is returned to the tank sump via the external fuel return line.

**⚠WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**

*NOTE*

*Before removing the fuel pump, perform appropriate diagnostics listed in the VRSC ELECTRICAL DIAGNOSTIC MANUAL.*

### Removal

1. See Figure 4-38. Remove fuel pump electrical connector (9) from fuel pump.
2. Depress fuel pump supply hose mounting tabs (8) and disconnect fuel pump supply hose (1).
3. Depress suction side fuel filter mounting tabs (7) and disconnect suction side filter (4).
4. Remove fuel pump (5) and vibration isolator (rubber damper) from housing.
5. Push fuel pump up and out of its bracket.
6. Inspect all fuel pump and fuel level sending unit wiring.

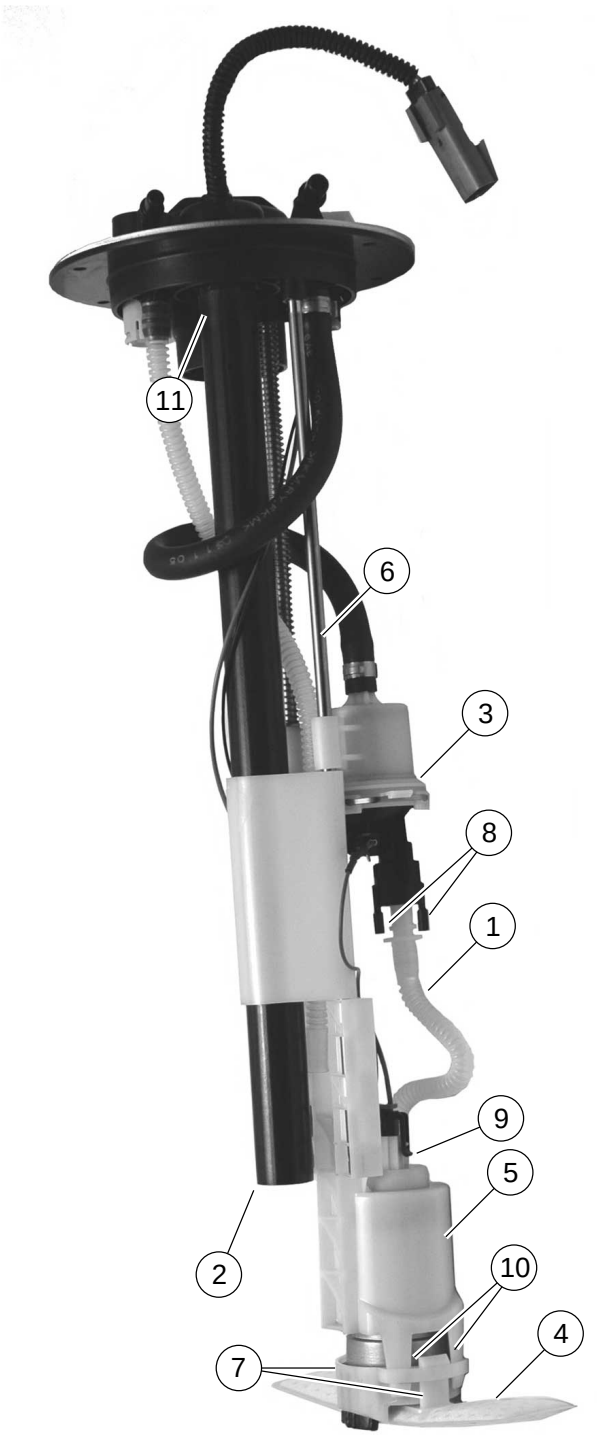
*NOTE*

*Carefully inspect hoses for cuts, tears, holes or other damage. Replace hose if any damage is found. Even the smallest hole can cause a reduction in fuel pressure.*

### Installation

1. See Figure 4-38. Route fuel pump supply hose (1) through cavity in fuel pump housing and install **new** fuel pump (5) with vibration isolator (rubber damper) into housing.
2. Insert fuel pump supply hose into fuel filter canister base until an audible click is heard.
3. Align fuel pump so suction side filter pickup is located between two fuel pump retaining cap mounting tabs and install fuel pump retaining cap but pushing cap into place until an audible click is heard.
4. Install **new** suction side filter (4) by pressing into place until an audible click is heard.
5. Press fuel pump electrical connector (9) into place until an audible click is heard.
6. Install fuel pump/filter/fuel level sensor into fuel tank.
7. After installation of fuel pump/filter/fuel level sensor assembly, verify fuel pump operation with a fuel system pressure test. See 4.13 FUEL PRESSURE TEST.

sm01180




1. Fuel pump supply hose
2. Fuel level sensor (FLS)
3. Pressure side filter
4. Suction side filter
5. Fuel pump (located inside of housing)
6. Support rod
7. Suction side fuel filter mounting tabs
8. Fuel pump supply hose mounting tabs
9. Fuel pump electrical connector
10. Fuel pump retaining cap
11. Fuel level sensor retaining clip

**Figure 4-38. Fuel Pump, Filter and Sensor Assembly (typical)**

## FUEL LEVEL SENSOR

**WARNING**

**Gasoline can drain from components when disconnected from fuel pump/filters/fuel level sender assembly. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00273a)**

### Removal

1. See Figure 4-38. Using a snap-ring pliers, remove fuel level sensor retaining clip (11).
2. Slide fuel level sensor (2) up and out top plate of fuel pump/filter/fuel level sensor assembly.

### Installation

1. See Figure 4-38. Slide fuel level sensor assembly into top plate of fuel pump/filter/fuel level sensor assembly.
2. Using snap-ring pliers, install snap ring (11).
3. Install fuel pump/filter/fuel level sensor assembly into gas tank.
4. Connect fuel level sensor connector [13B].
5. Verify that the fuel gauge indicates the corresponding fuel level after installing the fuel pump/filter/fuel level sensor assembly.

## GENERAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48650 | DIGITAL TECHNICIAN II |

**⚠WARNING**

**When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)**

The fuel pump is located in the fuel tank. It delivers fuel to the fuel metering assembly. The fuel metering assembly contains the fuel injectors, and the pressure regulator where the system pressure is controlled. Excess fuel pressure is returned to the fuel tank by a return line. The ECM controls the system relay that supplies 12 VDC to the fuel pump.

When the engine is stopped, the fuel pump can be turned on by applying battery voltage to pin 1 and ground to pin 3 of the fuel pump connector [86A] or by using DIGITAL TECHNICIAN II (Part No. HD-48650).

Improper fuel system pressure may contribute to one of the following conditions:

- Cranks, but won't run.
- Cuts out (may feel like ignition problem).
- Hesitation, loss of power or poor fuel economy.

*NOTE*

*See the ELECTRICAL DIAGNOSTIC MANUAL for further information on the function and testing of the fuel system.*

## TESTING

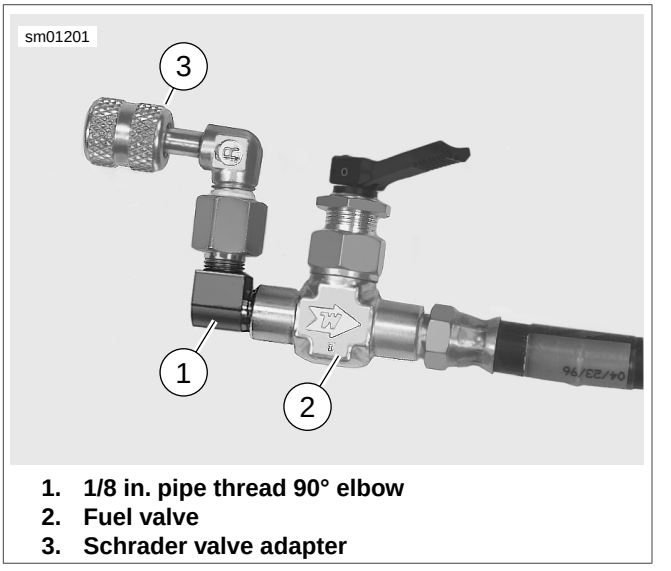
| PART NUMBER | TOOL NAME |
|---|---|
| HD-41182 | FUEL PRESSURE GAUGE |

The fuel pressure gauge (0-100 PSI) allows for fuel injector and fuel system pressure diagnosis.

1. See Figure 4-39. Disconnect fuel pump connector from top of fuel tank.
2. Start the engine and allow the vehicle to run.
3. When engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines. Turn ignition key off.
4. See Figure 4-40. Insert a 1/8 in. pipe thread 90° (right angle) elbow (1) between the fuel valve (2) and the Schrader valve adapter (3).
5. See Figure 4-41. Remove protective cap from Schrader valve in fuel metering assembly.
6. Verify that the fuel valve and air bleed petcock on the FUEL PRESSURE GAUGE (Part No. HD-41182) are closed.




**Figure 4-39. Fuel Pump Connector [86] (typical)**




1. **1/8 in. pipe thread 90° elbow**
2. **Fuel valve**
3. **Schrader valve adapter**

**Figure 4-40. Fuel Pressure Gauge Valves**

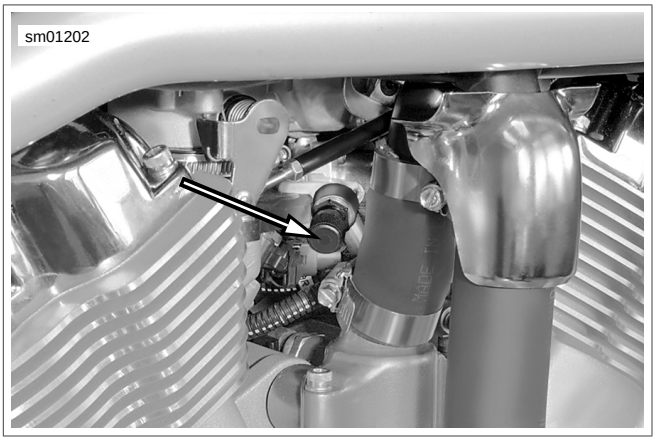



**Figure 4-41. Schrader Valve Location (typical)**

7. Connect fuel pressure gauge to Schrader valve. Connect fuel pump connector.
8. Start and idle engine to pressurize the fuel system. Open the fuel valve to allow the flow of fuel down the hose of the pressure gauge.
9. Position the clear air bleed tube in a suitable container and open and close the air bleed petcock to purge the gauge and hose of air. Repeat this step several times until only solid fuel (without bubbles) flows from the air bleed tube. Close the petcock.
10. Open and close throttle to change engine speed. Note the reading of the pressure gauge. Fuel pressure should remain steady at 380-425 kPa (55-62 psi).
11. Turn the engine off. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.

**⚠WARNING**

**Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)**

12. Remove fuel pressure gauge from the Schrader valve in fuel metering assembly. Install protective cap over Schrader valve.

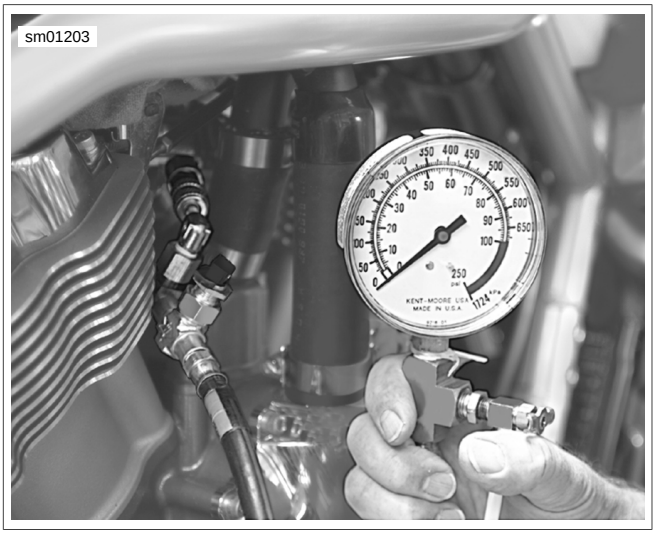


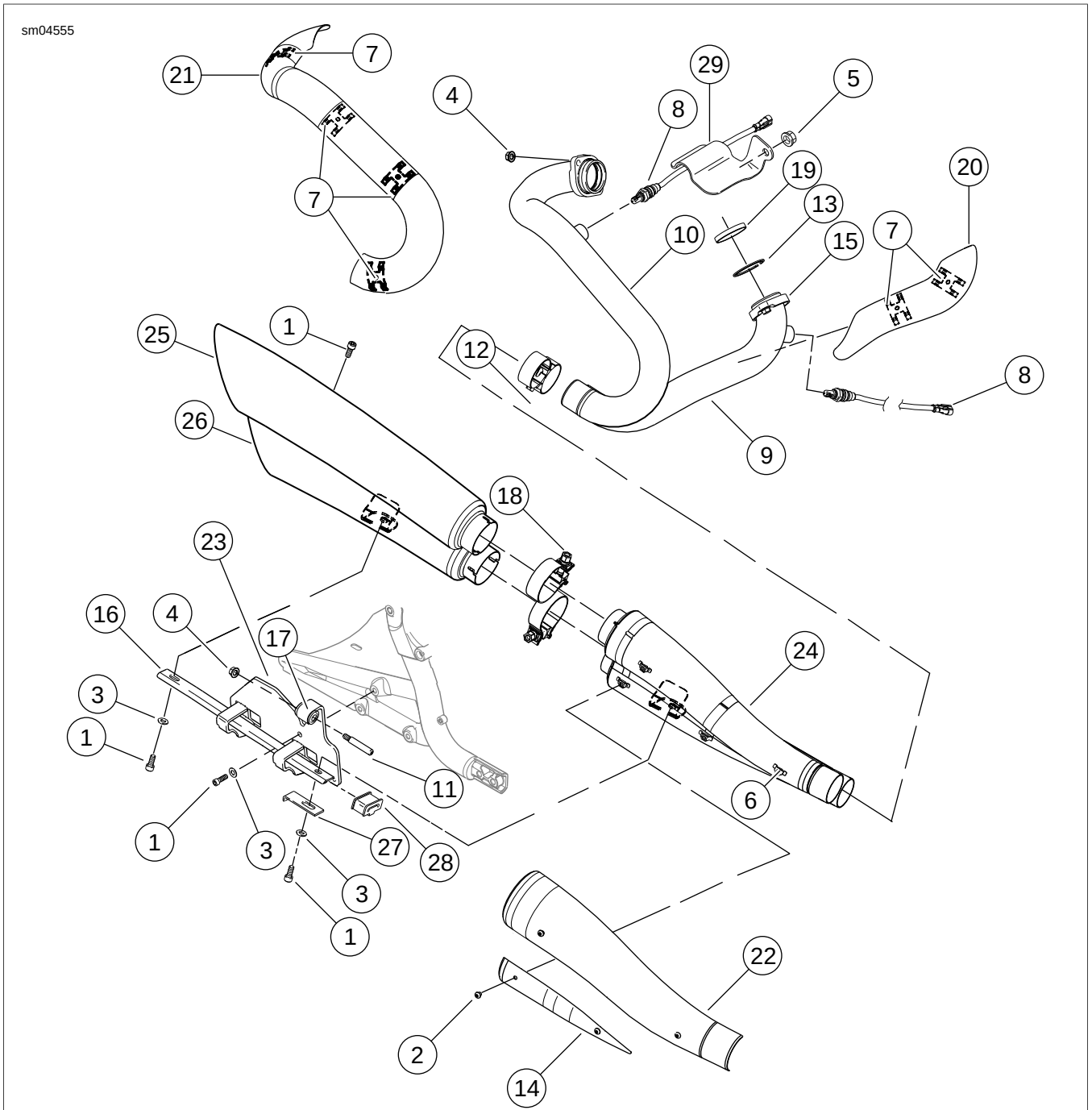

**Figure 4-42. Fuel Pressure Gauge Installed**

## REMOVAL

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. See Figure 4-43. Loosen upper muffler clamp (18).




1. **Screw (7)**
2. **Screw (5)**
3. **Washer (7)**
4. **Nut (5)**
5. **Nut**
6. **Nut (5)**
7. **Clamp (6)**
8. **Oxygen sensor (2)**
9. **Exhaust pipe, front**
10. **Exhaust pipe, rear**
11. **Pin**
12. **Clamp, exhaust**
13. **Retaining ring (2)**
14. **Shield, lower exhaust**
15. **Flange, exhaust (2)**
16. **Support bar**
17. **Isolator mount**
18. **Clamp, exhaust (2)**
19. **Seal, exhaust (2)**
20. **Exhaust shield assembly, front**
21. **Exhaust shield assembly, rear**
22. **Exhaust shield, upper**
23. **Exhaust support**
24. **Auxiliary volume**
25. **Muffler, top**
26. **Muffler, bottom**
27. **Bracket, exhaust support**
28. **Rubber isolator (2)**
29. **Bracket, rear oxygen sensor cable**

**Figure 4-43. Exhaust System VRSCAW/VRSCAWA**

3. Remove the two fasteners (1) holding the upper muffler (25) to the bottom muffler (26).
4. Slide upper muffler rearward to disconnect from the auxiliary volume (24).

5. Remove both heat shields (21, 20) from front and rear header pipes. It's not necessary to remove the heat shield (14) from the auxiliary volume (24).
6. Remove the auxiliary volume fastener (1) and the lower muffler fastener (1) from the lower part of the exhaust support bracket. Save the L-bracket (27) found under the exhaust support.
7. Disconnect oxygen sensor (8) connectors from wiring harness.
8. Remove the left side drive sprocket cover for easier access to rear cylinder lower exhaust flange bolt.
9. Remove flanged hex-nuts (4) holding exhaust flange to front and rear cylinders.
10. Remove hex-nut (4) and pin (11) on exhaust support bracket.
11. Remove front exhaust pipes from cylinder heads.

## INSTALLATION

*NOTE*

*Do not torque fasteners until required to do so by the following installation instructions. Hand tightening each fastener will pull the exhaust system into a position that will allow the crush of the exhaust gaskets during the torquing sequence to draw the exhaust system up to the engine.*

1. Install **new** exhaust seals (19).
2. See Figure 4-43. Gently lift the lower muffler, auxiliary volume, and header pipe assembly into position.

*NOTE*

*An assistant may be required to hold the header pipes when aligning the exhaust header flanges with the studs in the cylinder heads.*

3. Slip both front and rear header flanges (15) over the studs in the cylinder heads. Thread hex-nuts (4) on header flange studs. Do not tighten.
4. Install support pin (11) in isolator mount (17) on the exhaust support. Thread on the hex-nut (4). Do not tighten.
5. Hold a 1/2 in. spacer between the frame rail and the header pipe exhaust clamp.
6. Thread in the lower muffler fastener (1) through the exhaust support.
7. Thread in the auxiliary volume fastener (1) through the L-bracket (27) and the exhaust support. Do not tighten.
8. Torque the pin hex-nut to 23 Nm (17 ft-lbs).

*NOTE*

*TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that the muffler clamp assemblies be discarded and replaced each time they are removed.*

9. Place clamp (18) on upper muffler (25). Slide muffler over upper opening of auxiliary volume (24). Position clamp with compression fastener to inboard with tightening nut upward.
10. Thread upper muffler fasteners (1) into the lower muffler (26). Do not tighten.
11. Torque the fasteners to the indicated torque in the following order:
    a. Upper muffler clamp - 65 Nm (48 ft-lbs).
    b. Upper muffler fasteners - 23 Nm (17 ft-lbs).
    c. Lower muffler fasteners - 23 Nm (17 ft-lbs).
    d. Auxiliary volume fasteners - 23 Nm (17 ft-lbs).
    e. Exhaust flange hex-nuts - 8-12 Nm (71-106 **in-lbs**).
12. Check the tightness of the exhaust clamp by tightening the clamp nut to 32-37 Nm (24-27 ft-lbs).
13. Reinstall front and rear heat shields. Tighten the heat shield fasteners to 10 Nm (88 **in-lbs**).
14. If removed, reinstall drive sprocket cover. Tighten to 6-10 Nm (53-88 **in-lbs**).
15. Mate oxygen sensor connectors to wiring harness.
16. Install the maxi-fuse and the right side cover.

## REMOVAL

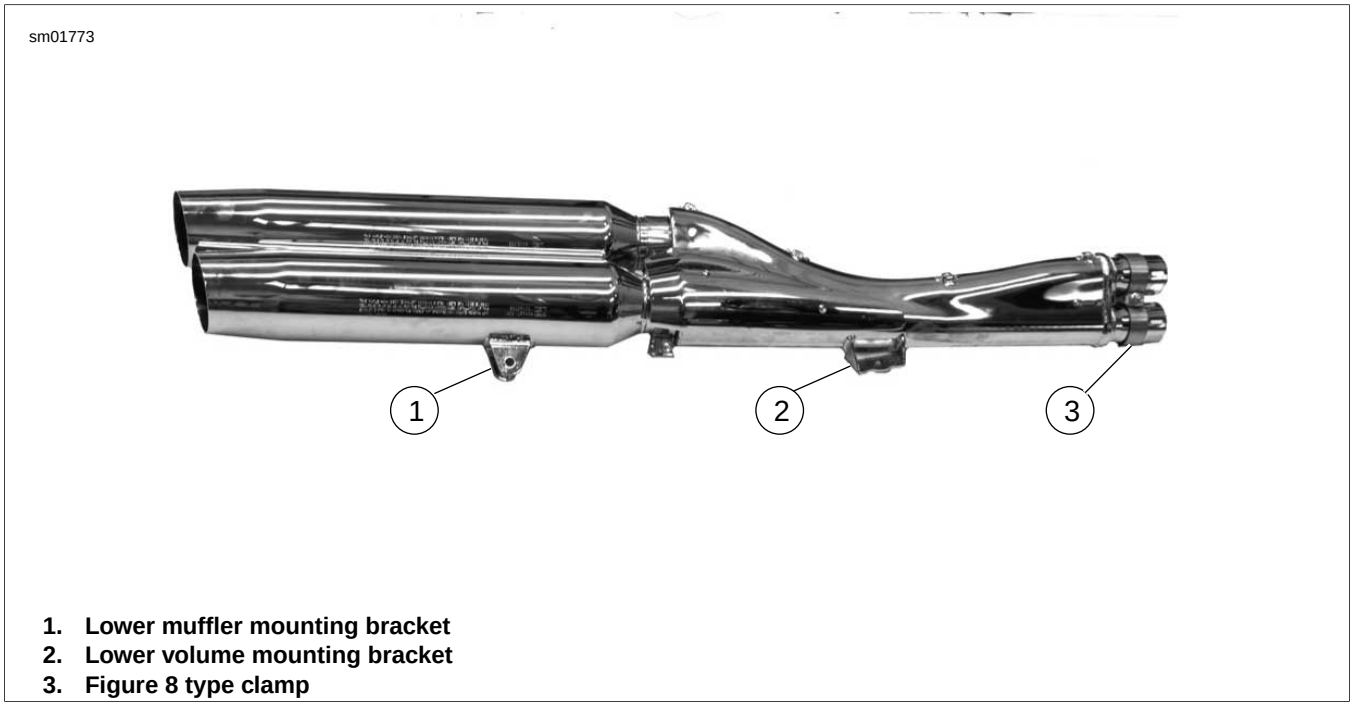
**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

*NOTE*

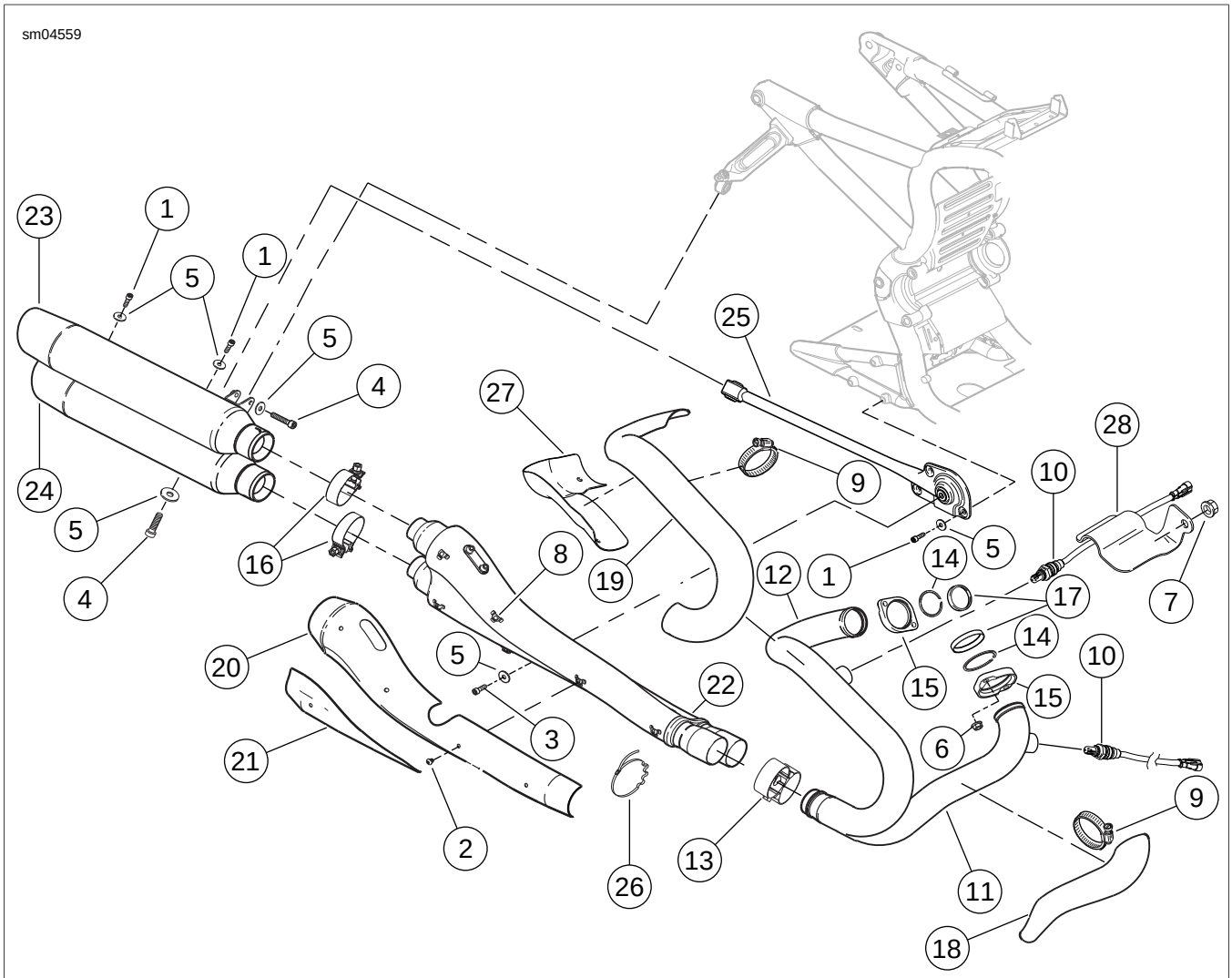
*The exhaust system can be removed as a complete unit from the primary tubes back. It is not necessary to remove the heat shields or passenger footrest pad from muffler assembly.*

1. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. See Figure 4-44. Loosen figure 8 type clamp (3).
3. See Figure 4-45. Remove passenger right side footrest assembly. See 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT.
4. See Figure 4-46. Remove exhaust bracket fastener from passenger right side footrest.
5. Remove lower muffler mounting fasteners.
6. Remove auxiliary volume mounting fastener.
7. Holding exhaust system firmly, use an up and down motion at the back of the mufflers while pulling exhaust system back and away from primary tubes until exhaust system is free from motorcycle.
8. See Figure 4-47. Note lower support fastener locations. It is not necessary to remove this bracket from motorcycle.




1. **Lower muffler mounting bracket**
2. **Lower volume mounting bracket**
3. **Figure 8 type clamp**

**Figure 4-44. Exhaust System Lower Mounting Brackets**




1. **Screw (5)**
2. **Screw (6)**
3. **Screw**
4. **Screw (2)**
5. **Washer (8)**
6. **Nut (4)**
7. **Nut**
8. **Nut (6)**
9. **Clamp (6)**
10. **Oxygen sensor (2)**
11. **Exhaust pipe, front**
12. **Exhaust pipe, rear**
13. **Clamp, exhaust**
14. **Retaining ring (2)**
15. **Exhaust flange (2)**
16. **Clamp, exhaust (2)**
17. **Seal (2)**
18. **Exhaust shield assembly (front)**
19. **Exhaust shield assembly (rear)**
20. **Exhaust shield, upper**
21. **Exhaust shield, lower**
22. **Auxiliary volume**
23. **Muffler, top**
24. **Muffler, bottom**
25. **Exhaust support assembly**
26. **Strap**
27. **Lower pipe shield**
28. **Bracket, rear oxygen sensor cable**

**Figure 4-45. Exhaust System (VRSCD/VRSCDA)**

## INSTALLATION

*NOTES*

- *Before installing exhaust system, verify brake hose between rear brake master cylinder and reservoir is installed securely into frame clips and no clamps are missing or damaged. Failure to verify can cause brake hose to contact hot exhaust system which can result in loss of control of motorcycle and result in death or serious injury.*
- *If for any reason, AV heat shields or AV heat shield fasteners were removed from exhaust system, they must be replaced with **new** fasteners and tightened properly. Failure to do so can result in the heat shield coming loose*

*and interfering with rear brake pedal operation which can cause loss of vehicle control and death or serious injury.*

- *If thin metal band is removed for any reason from front of volume heat shield, it must be replaced with a **new** band. Failure to replace band may result in heat shield making contact with rear brake lever which can result in death or serious injury.*
- *An assistant may be required to hold the exhaust pipes while guiding exhaust system onto motorcycle.*

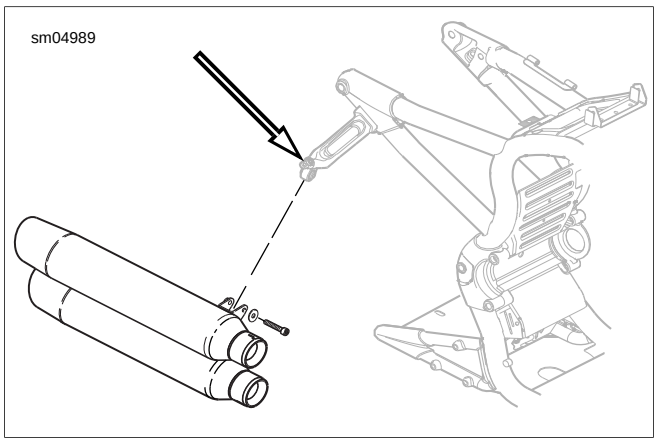



**Figure 4-46. Right Side Passenger Footrest/Exhaust Bracket Fastener**

1. Verify brake hose between master cylinder and reservoir is completely seated in retainer clips along lower frame tube Replace any damaged or missing clips and verify that brake hose is as far inboard of frame tube as possible.
2. Install **new** Figure 8 muffler clamp.
3. Gently lift the exhaust system assembly into position.
4. Have assistant guide the pipes from the muffler assembly into the exhaust pipes. Make sure heat shield on muffler assembly fits over heat shield on exhaust pipes.
5. See Figure 4-47. Install all fasteners loosely. Do not tighten at this time.

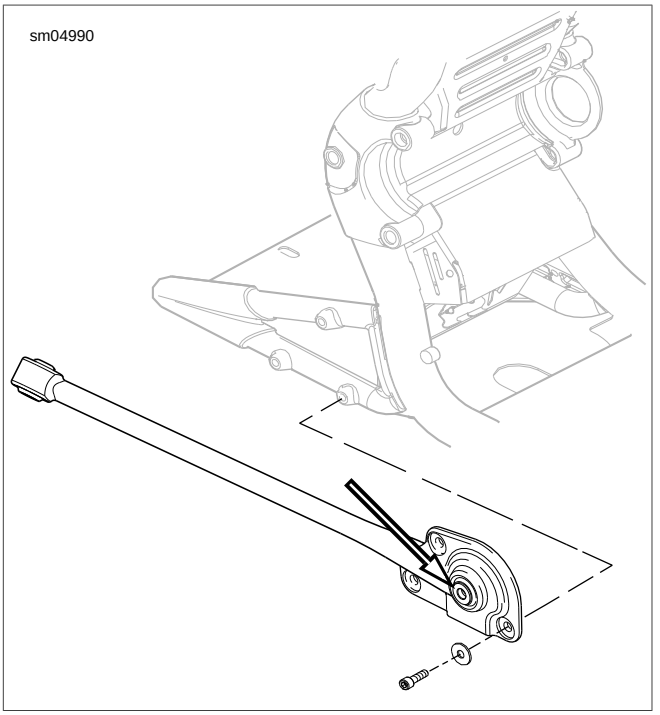



**Figure 4-47. Exhaust Lower Support Fastener Location**

6. Install passenger footrest and bracket assembly. See 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT.
7. Tighten lower muffler mounting fastener to 19-27 Nm (14-20 ft-lbs) and lower volume mounting fasteners to 19-27 Nm (14-20 ft-lbs).
8. Tighten figure 8 clamp to 30-34 Nm (22-25 ft-lbs).

*NOTE*

*Check clearance between bottom of exhaust and frame of motorcycle. There should be a measured clearance no less than 5.7 mm (7/32 in). Clearance less than this can result n damage to the rear brake reservoir to master cylinder hose which can cause loss of vehicle control and death or serious injury.*

9. Check clearance between frame and exhaust system. Clearance should be no less than 5.7 mm (7/32 in). If adjustment is necessary, loosen exhaust pipes, all mounting fasteners and reposition exhaust system and check clearance again.
10. Confirm thin metal band around front of heat shield is securely in place.

## EXHAUST PIPES

### Removal

If it is necessary to remove exhaust pipes, first perform steps necessary to remove rear part of exhaust system.

1. Disconnect oxygen sensor connectors from wiring harness.
2. Remove fasteners holding exhaust pipes to cylinder heads.
3. Remove exhaust pipes from cylinder heads and discard old seals.

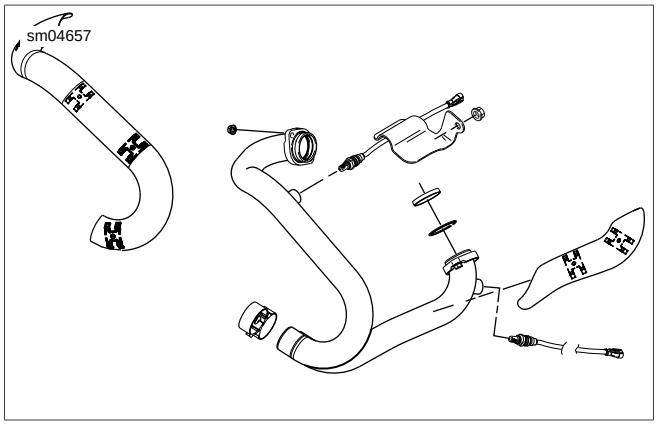



**Figure 4-48. Exhaust Pipes (typical)**

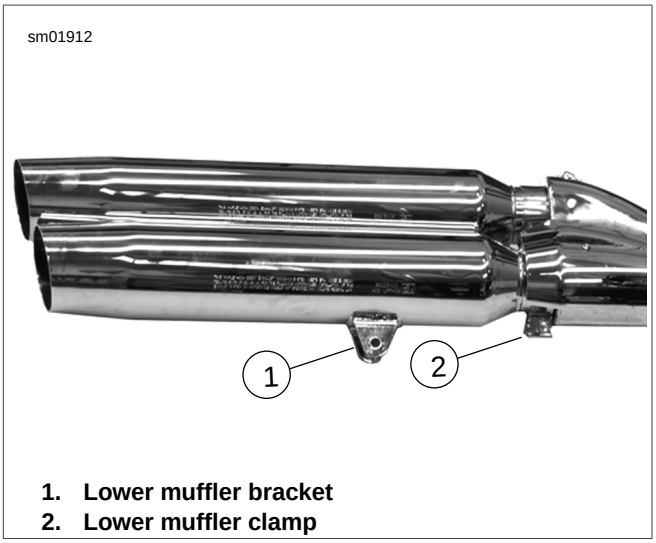
## Installation

1. Install **new** exhaust pipe seals.
2. Install exhaust pipes to cylinder heads and install fasteners. Do not tighten at this time.
3. Install complete exhaust system and perform alignment checks to verify clearance between exhaust and frame tube.
4. Tighten exhaust pipe to cylinder head fasteners to 8-12 Nm (71-106 **in-lbs**).
5. Mate oxygen sensor connectors to wiring harness.

# MUFFLERS

## Removal

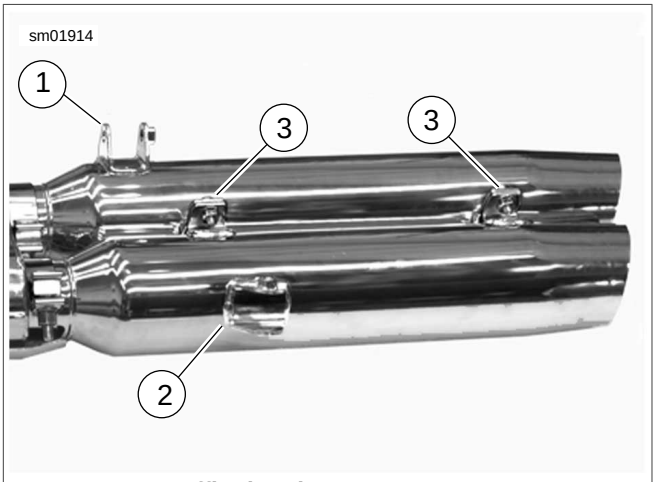
1. Remove lower muffler by doing the following:
   a. Loosen lower muffler clamp.
   b. Remove fastener from lower muffler to bracket.
   c. Remove muffler to muffler fasteners (3).
   d. Holding muffler firmly; and if necessary, use an up and down motion at the back of the muffler while pulling muffler back and away from exhaust system until muffler is free from motorcycle.




1. **Lower muffler bracket**
2. **Lower muffler clamp**

**Figure 4-49. Lower Clamp and Bracket Locations (VRSCD shown)**

2. Remove upper muffler by doing the following:
   a. Loosen upper muffler clamp.
   b. Remove fastener from upper muffler to footpeg bracket.
   c. Holding muffler firmly, use an up and down motion at the back of the muffler while pulling muffler back and away from exhaust system until muffler is free from motorcycle.




1. **Upper muffler bracket**
2. **Upper muffler clamp**
3. **Muffler to muffler fasteners**

**Figure 4-50. Upper Clamp and Bracket Locations (VRSCD shown)**

## Installation

*NOTE*

*TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that the muffler clamp assemblies be discarded and replaced each time they are removed.*

1. Install lower muffler by doing the following:
   a. Put muffler clamp in place for installation.
   b. Holding muffler firmly, use an up and down motion at the back of the muffler while pushing muffler onto existing exhaust system until muffler is in place.
   c. Install fastener loosely from lower muffler to bracket.
   d. Tighten muffler clamp to 30-34 Nm (22-25 ft-lbs).

2. Install upper muffler by doing the following:
   a. Put muffler clamp in place for installation.
   b. Holding muffler firmly; and if necessary, use an up and down motion at the back of the muffler while pushing muffler onto existing exhaust system until muffler is in place.
   c. Install fastener loosely from upper muffler to footpeg bracket.
   d. Loosely install muffler to muffler fasteners (3).
   e. Tighten both muffler to muffler fasteners to 23 Nm (17 ft lbs).
   f. Tighten upper and lower muffler fasteners to 23 Nm (17 ft lbs).

## REMOVAL

**⚠WARNING**

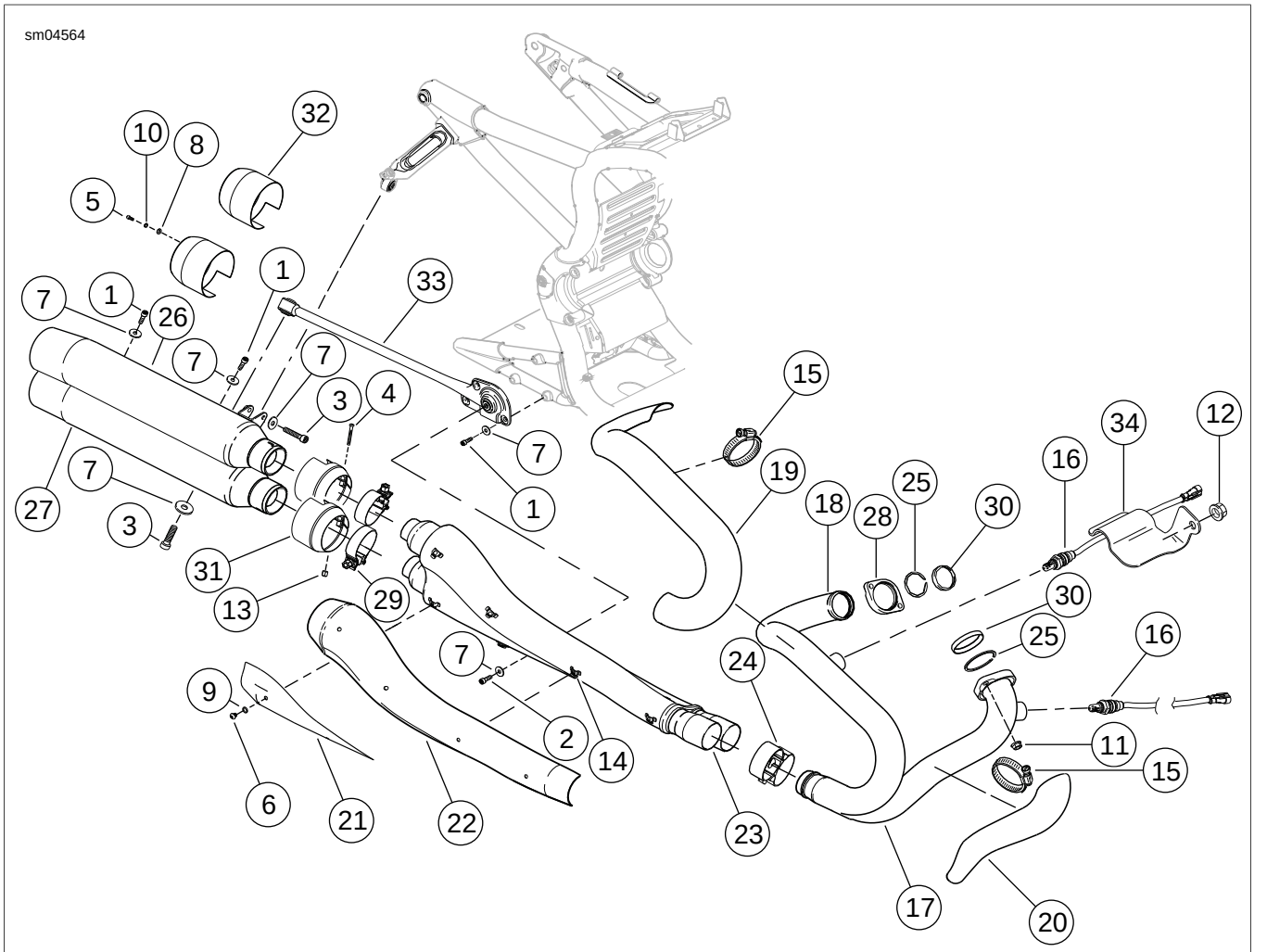
**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

*NOTE*

*The exhaust system can be removed as a complete unit from the tubes back, however it will also be necessary to remove the heat shields from volume assembly.*

*The VRSCDX/VRSCDXA uses a unique finish on some exhaust system components. Improper care and handling during the disassembly/assembly process can cause permanent cosmetic finish damage.*

1. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. See Figure 4-51. Loosen clamp (24).
3. Remove passenger right side footrest assembly. See 2.8 FOOTRESTS AND FOOT CONTROLS: FORWARD MOUNT.
4. See Figure 4-52. Remove exhaust bracket fastener from passenger right side footrest.
5. Remove lower muffler mounting fastener.
6. Remove AV mounting fastener.
7. Holding exhaust system firmly, use an up and down motion at the back of the mufflers while pulling exhaust system back and away from tubes until exhaust system is free from motorcycle.
8. See Figure 4-53. Note lower support fastener locations. It is not necessary to remove this bracket from motorcycle.




1. **Screw (5)**
2. **Screw**
3. **Screw (2)**
4. **Screw (4)**
5. **Screw (6)**
6. **Screw (6)**
7. **Washer (8)**
8. **Washer (6)**
9. **Washer (6)**
10. **Lockwasher (6)**
11. **Nut (4)**
12. **Nut**
13. **Nut (4)**
14. **Nut (6)**
15. **Clamp (6)**
16. **Oxygen Sensor (2)**
17. **Exhaust pipe, front**
18. **Exhaust pipe, rear**
19. **Exhaust shield, rear**
20. **Exhaust shield, front**
21. **Exhaust shield, lower**
22. **Exhaust shield, upper**
23. **Auxiliary volume**
24. **Clamp**
25. **Retaining ring (2)**
26. **Muffler, top**
27. **Muffler, bottom**
28. **Flange, exhaust (2)**
29. **Clamp, exhaust (2)**
30. **Seal, exhaust (2)**
31. **Endcap, muffler inlet (2)**
32. **Endcap, muffler outlet (2)**
33. **Exhaust support assembly**
34. **Bracket, rear oxygen sensor cable**

**Figure 4-51. Exhaust System (VRSCDX/VRSCDXA)**

## INSTALLATION

*NOTES*

- *Before installing exhaust system, verify brake hose between rear brake master cylinder and reservoir is installed securely into frame clips and no clamps are missing or damaged. Failure to verify can cause brake hose to contact hot exhaust system which can result in loss of control of motorcycle and result in death or serious injury.*
- *If for any reason, AV heat shields or AV heat shield fasteners were removed from exhaust system, they must be replaced with **new** fasteners and tightened properly. Failure to do so can result in the heat shield coming loose*

*and interfering with rear brake pedal operation which can cause loss of vehicle control and death or serious injury.*

- *An assistant may be required to hold the exhaust pipes while guiding exhaust system onto motorcycle.*

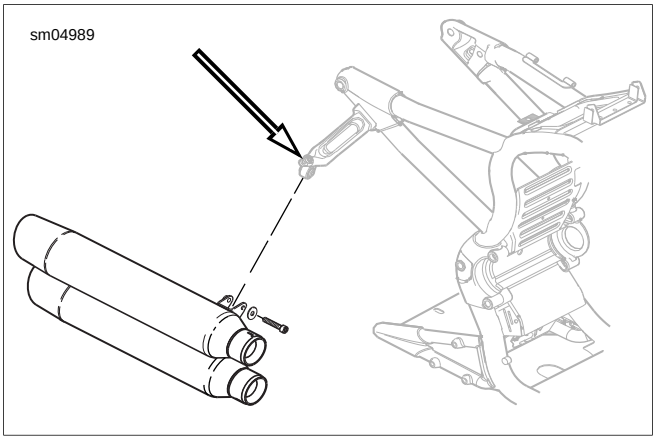



**Figure 4-52. Right Side Passenger Footrest/Exhaust Bracket Fastener**

1. Verify brake hose between master cylinder and reservoir is completely seated in retainer clips along lower frame tube Replace any damaged or missing clips and verify that brake hose is as far inboard of frame tube as possible.
2. Install **new** figure 8 clamp.
3. Gently lift the exhaust system assembly into position.
4. Have assistant guide the pipes from the muffler assembly into the exhaust pipes. Make sure heat shield on muffler assembly fits over heat shield on exhaust pipes.
5. See Figure 4-51. Install all fasteners loosely. Do not tighten at this time.

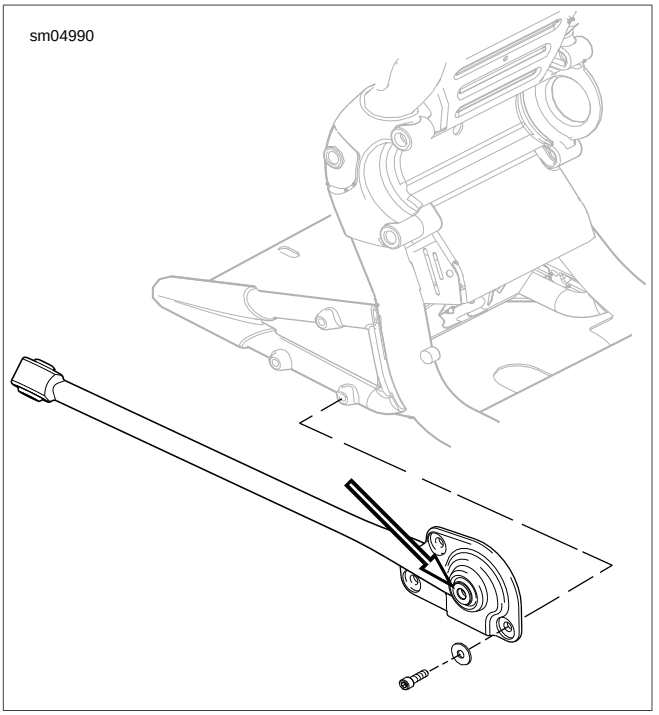



**Figure 4-53. Exhaust Lower Support Fastener Location**

6. Install passenger footrest and bracket assembly. See 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT.
7. Tighten lower muffler mounting fastener to 19-27 Nm (14-20 ft-lbs) and lower volume mounting fasteners to 19-27 Nm (14-20 ft-lbs).
8. Tighten figure 8 clamp to 30-34 Nm (22-25 ft-lbs).

*NOTE*

*Check clearance between bottom of exhaust and frame of motorcycle. There should be a measured clearance no less than 5.7 mm (7/32 in). Clearance less than this can result in damage to the rear brake reservoir to master cylinder hose which can cause loss of vehicle control and death or serious injury.*

9. Check clearance between frame and exhaust system. Clearance should be no less than 5.7 mm (7/32 in). If adjustment is necessary, loosen exhaust pipes, all mounting fasteners and reposition exhaust system and check clearance again.

## GENERAL

See Figure 4-54. The vapor valve is mounted in the fuel tank top plate. Hydrocarbon vapors in the fuel tank are vented through the vapor valve and then through the vapor valve hose to the carbon canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.

## REPLACEMENT

The vapor valve is integrated into the fuel tank top plate and is not individually replaceable. If replacement is necessary, the fuel tank top plate must be replaced.

*NOTE*

*On non-California models, the bottom hose is vented to the atmosphere. On California models, the hose from the vapor valve bottom fitting goes to a evaporative (EVAP) emissions control system. See 4.19 EVAPORATIVE EMISSIONS CONTROL (CA MODELS).*

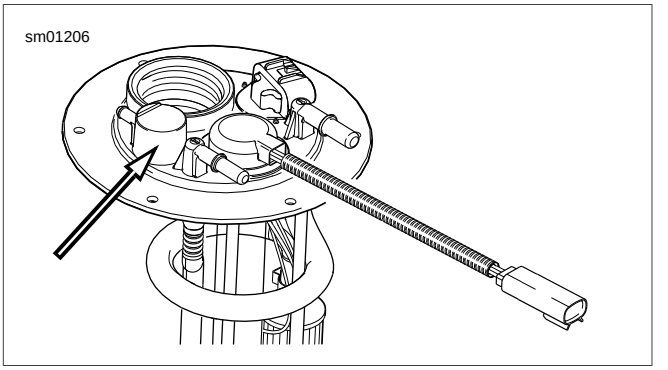



**Figure 4-54. Vapor Valve**

## GENERAL

**WARNING**

**Do not allow open flame or sparks near propane. Propane is extremely flammable, which could cause death or serious injury. (00521b)**

**WARNING**

**Read and follow warnings and directions on propane bottle. Failure to follow warnings and directions can result in death or serious injury. (00471b)**

*NOTES*

- *To prevent false readings, keep air cleaner cover installed when performing test.*
- *Do not direct propane into air cleaner; false readings will result.*
- *Be careful when testing vehicle with Screamin' Eagle air cleaner assembly. This type of air cleaner has an open backing plate. Even with air cleaner cover on, directing nozzle too close to backing plate can give false readings.*

## LEAK TESTER

| PART NUMBER | TOOL NAME |
|---|---|
| HD-41417 | PROPANE ENRICHMENT KIT |

### Parts List

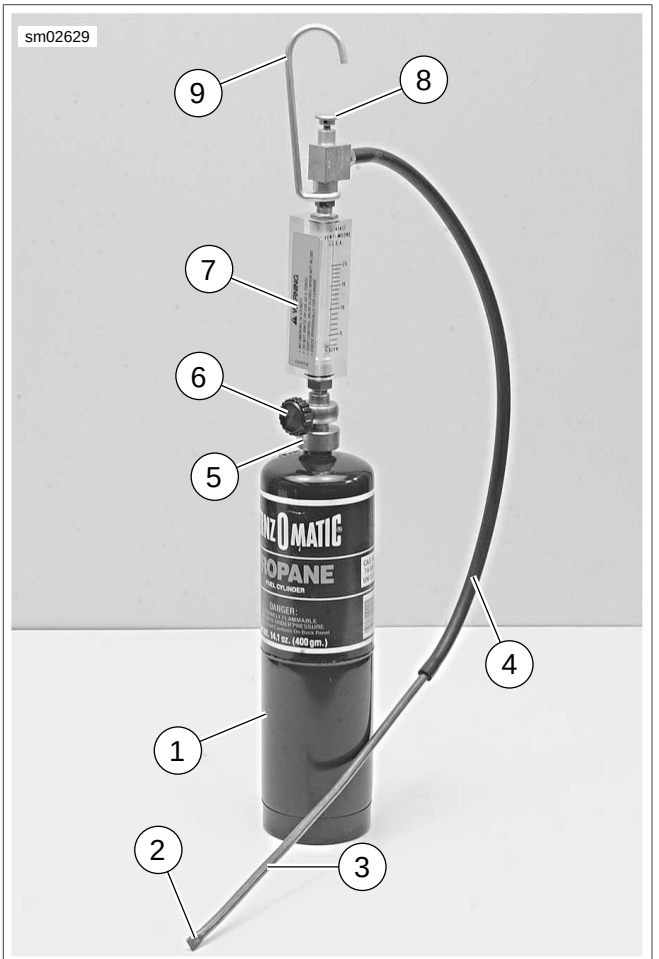
- Standard 14 oz. propane cylinder.
- PROPANE ENRICHMENT KIT (Part No. HD-41417).

### Tester Assembly

1. See Figure 4-55. Make sure valve knob (6) is closed (fully clockwise).
2. Screw valve assembly (5) onto propane bottle (1).

### Tester Adjustment

1. See Figure 4-55. Press and hold trigger button (8).
2. Slowly open valve knob (6) until pellet in flow gauge (7) rises to between 5 and 10 SCFH on gauge.
3. Release trigger button.




1. **Propane bottle**
2. **Nozzle**
3. **Copper tube**
4. **Hose**
5. **Valve assembly**
6. **Valve knob**
7. **Flow gauge**
8. **Trigger button**
9. **Hanger**

**Figure 4-55. Leak Tester**

## PROCEDURE

1. Start engine.
2. Warm up engine to operating temperature.

**WARNING**

**Do not allow open flame or sparks near propane. Propane is extremely flammable, which could cause death or serious injury. (00521b)**

*NOTE*

*Do not direct propane stream toward front of engine. If propane enters air horn, a false reading will be obtained.*

3. See Figure 4-56. Aim nozzle toward possible sources of leak such as intake manifold mating surfaces.

4. Press and release trigger button to dispense propane. Tone of engine will change when propane enters source of leak. Repeat as necessary to detect leak.
5. When test is finished, close valve knob (turn knob fully clockwise).




**Figure 4-56. Checking for Leaks (typical)**

# EVAPORATIVE EMISSIONS CONTROL (CA MODELS) 4.19

## GENERAL

Harley-Davidson motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations in effect at the time of manufacture.

The EVAP functions in the following manner:

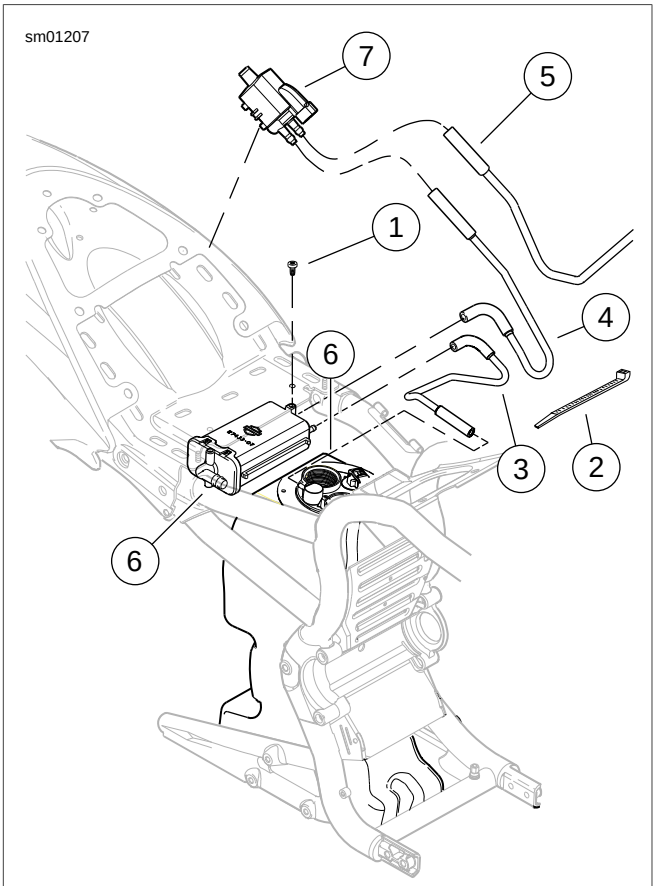
- Hydrocarbon vapors in the fuel tank are directed through the vapor valve and stored in the carbon canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent tube.
- When the engine is running, intake venturi negative pressure (vacuum) draws off the hydrocarbon vapors from the carbon canister when the purge solenoid is open. These vapors pass through the intake and are burned as part of normal combustion in the engine. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed.

**⚠WARNING**

**Keep evaporative emissions vent lines away from exhaust and engine. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00266a)**

*NOTE*

*The EVAP system has been designed to operate with a minimum of maintenance. Check that all tubes are properly connected, are not pinched or kinked and are routed properly. Improper connections could leak carbon from canister.*




1. **Fastener (2)**
2. **Cable Strap**
3. **Tube, tank to vapor valve**
4. **Tube, canister to solenoid**
5. **Tube, solenoid to throttle body**
6. **Carbon canister assembly**
7. **Purge valve solenoid**

**Figure 4-57. Evaporative Emissions Control System**

## PURGE SOLENOID

The purge solenoid allows hydrocarbon vapor flow from the carbon canister to the throttle body. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed. The power for the solenoid comes from the system relay. The EVMS provides the path to ground to trigger the purge solenoid.

*NOTE*

*Before removing the purge solenoid, perform diagnostics listed in the appropriate VRSC ELECTRICAL DIAGNOSTIC MANUAL.*

### Removal

1. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

2. See Figure 4-57. Press tab on side of electrical caddy and slide purge solenoid (7) free from electrical caddy.
3. Disconnect the wire connector to the purge solenoid.
4. Gently pull off the carbon canister to purge solenoid tube (4).
5. Gently pull off the purge solenoid to throttle body tube (5).

### Installation

1. Slide purge solenoid (7) onto tab on side of electrical caddy until an audible click is heard.
2. Push on the purge solenoid to throttle body tube (5).
3. Push on the carbon canister to purge solenoid tube (4).
4. Connect wire connector.
5. Replace the maxi-fuse and the right side cover.

## CARBON CANISTER

### Removal/Inspection

The EVAP carbon canister is mounted under the frame directly in front of the electrical caddy. It can be accessed from under the rider seat.

1. See Figure 4-57. Note tube connections. Gently pull tubes (3, 4, and 5) off carbon canister (6).
2. Remove fasteners (1) and slide carbon canister from under frame.
3. Inspect and replace all tubes, and/or carbon canister as required.

### Installation

1. See Figure 4-57. Position **new** carbon canister under frame just in front of electrical caddy and install fasteners and tighten.
2. Attach tubes to canister connections as marked.
3. Install **new** EVAP system label on front frame down tube.

## TUBE ROUTING/REPLACEMENT

*NOTE*

*Record location of cable ties before removal. Install cable ties in same location when installing.*

**⚠WARNING**

**Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)**

1. Route purge solenoid tubes.
   a. See Figure 4-57. Attach the purge solenoid to throttle body tube (5) to the throttle body.
   b. Route purge solenoid to throttle body tube (5) under frame tube to purge solenoid (7). Install cable ties.
   c. Attach canister to purge solenoid tube (4) to purge solenoid.
   d. Route canister to purge solenoid tube (4) to the carbon canister (7). Attach tube to the fitting marked CARB (1) on left side of canister. Install cable ties.
2. Route fuel tank vapor vent tubes.
   a. Route fuel tank vent tube (3) along left side of frame to top or long end of the vapor valve (8) clipped on frame tube. Install cable ties. Gently press the tube onto the top plate outlet port and onto the long end of the vapor valve.
   b. Attach short segment of tube to the bottom or short end of the vapor valve and to the fitting marked TANK on carbon canister (6).

**SUBJECT** **PAGE NO.**
5.1 SPECIFICATIONS: STARTER....5-1
5.2 STARTER SYSTEM....5-2
5.3 STARTER RELAY....5-4
5.4 STARTER....5-5
5.5 STARTER SOLENOID....5-6

# NOTES

# SPECIFICATIONS: STARTER 5.1

## GENERAL

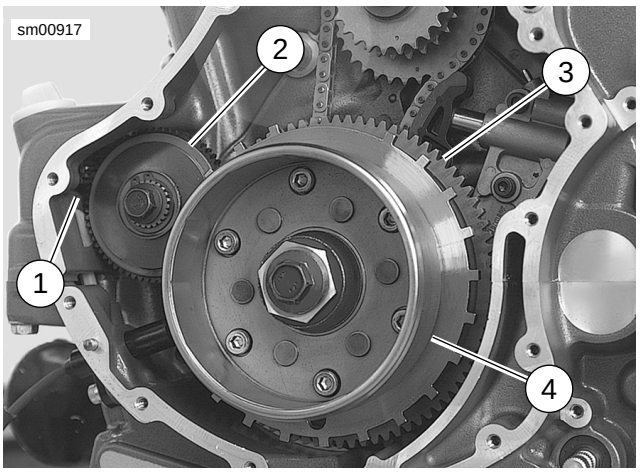
**Table 5-1. Starter Performance**

| STARTER | |
|---|---|
| Free speed | 9200 RPM (min) |
| Free current | 32 Amp |
| Cranking current | 180 Amp |

## GENERAL

The starter system is made up of the starter relay, starter solenoid, and starter motor. The starter drive gear engages a geared limiter assembly which engages a starter ring gear whose hub rotates inside a ball clutch on the rotor assembly.

The rotation of the starter is transferred to the crankshaft of the engine through the ball clutch. The starter motor torque is multiplied through the gear reduction of the starter drive gear to the limiter assembly gear and to the starter ring gear. The three gears remain in constant engagement.




1. **Starter drive gear**
2. **Limiter assembly**
3. **Starter ring gear**
4. **Rotor**

**Figure 5-1. Starter Drive (Left side engine cover/stator removed)**

### Wiring Diagrams

See Figure 5-2. For additional information concerning the starting system circuit, see the wiring diagrams in B.1 CONNECTORS.

### Starter Relay

The starter relay is not repairable. Replace the unit if it fails.

### Starter

The starter is not repairable. Replace the unit if it fails.

### Starter Solenoid

The starter solenoid is not repairable. Replace the unit if it fails.

## OPERATION

When the starter switch is pushed, the starter relay is activated which activates the starter solenoid allowing current to flow to the starter motor.

The starter drive gear transfers rotation to the limiter assembly and the limiter assembly gear transfers rotation to the starter ring gear. The starter ring gear drives the alternator rotor on the end of the crankshaft.

When the engine starts, a ball clutch on the back side of the rotor disengages allowing the starter ring gear and the rotor to rotate independently of each other.

*NOTE*

*For troubleshooting and diagnostic information see VRSC ELECTRICAL DIAGNOSTIC MANUAL.*

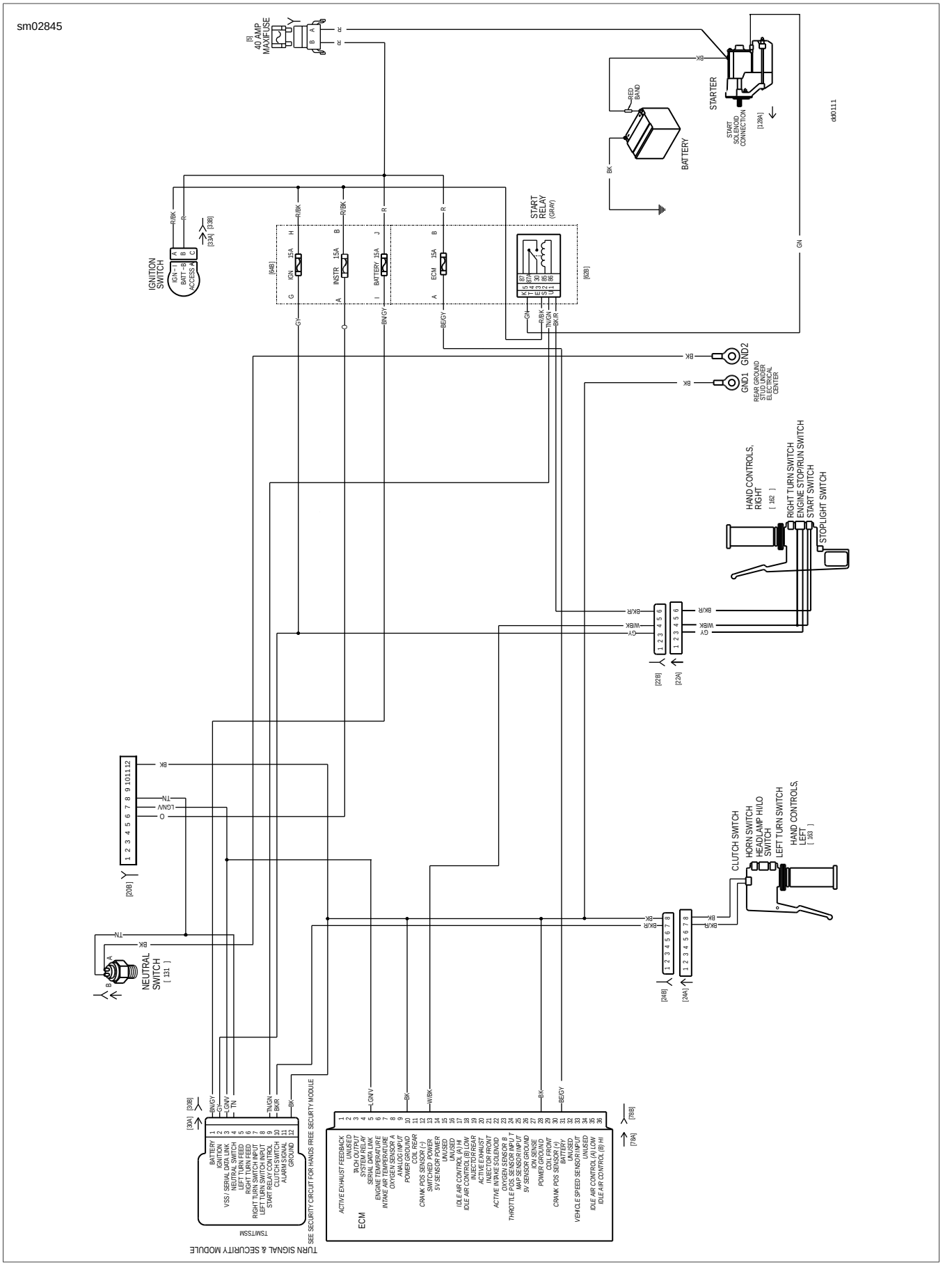



**Figure 5-2. Starting Circuit: Typical**

## REMOVAL

*NOTE*

*Before removing the relay, perform diagnostics listed in the ELECTRICAL DIAGNOSTIC MANUAL.*

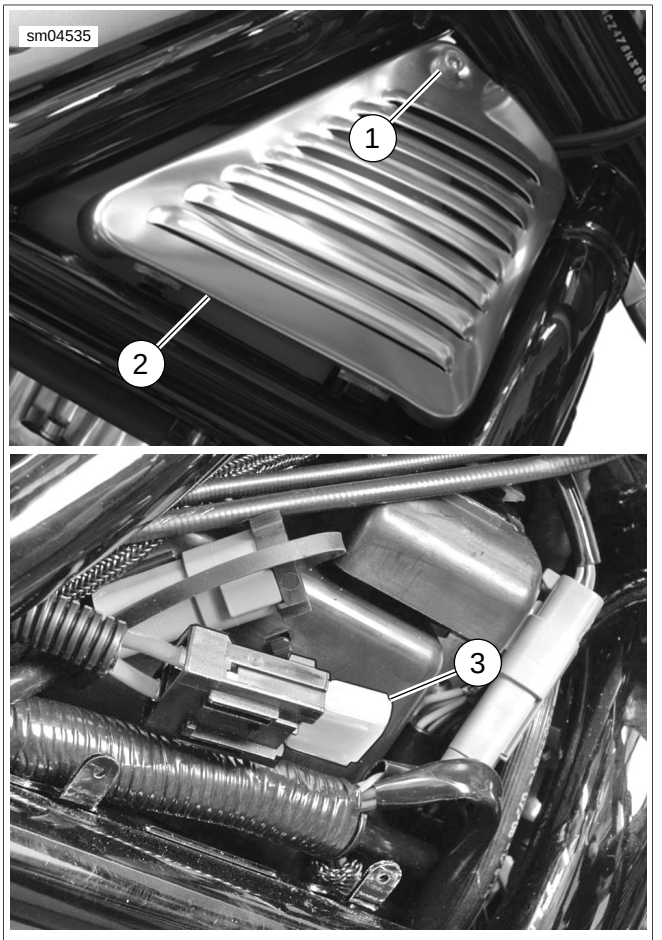
The starter relay is located beneath the right-side cover in the fuse block.

1. See Figure 5-3. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. Unlatch and open seat.
3. Remove the airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

4. Disconnect negative battery cable.
5. Remove starter relay from fuse block.




1. **Fastener**
2. **Side cover**
3. **Maxi-Fuse (40 amp)**

**Figure 5-3. Maxi-Fuse**

## INSTALLATION

1. Install relay in fuse block.
2. Slide cover over fuse blocks until latches fully engage tabs on blocks.
3. Slide fuse blocks onto frame mounting bracket. Tabs on bracket fit into slots on each side of fuse block cover.

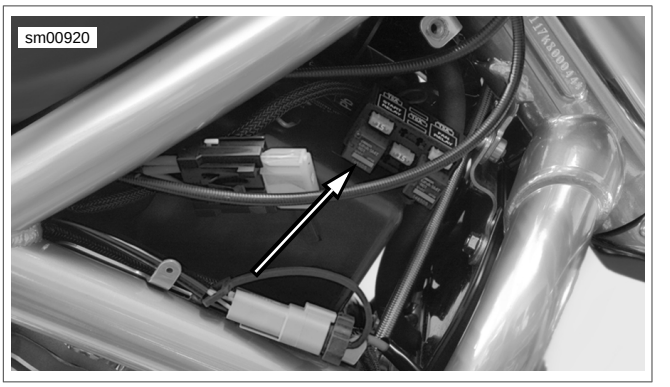



**Figure 5-4. Starter Relay**

**CAUTION**

**Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)**

**CAUTION**

**Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)**

**⚠WARNING**

**Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)**

4. Connect negative battery cable. See 1.9 BATTERY MAINTENANCE.
5. Install airbox cover by positioning the airbox cover with the locating pins in the holes on the frame tabs. Turn bailhead fastener 1/4 turn clockwise.
6. Reinstall maxi-fuse and right side cover.

## REMOVAL

*NOTE*

*Before removing the starter, perform diagnostics listed in the ELECTRICAL DIAGNOSTIC MANUAL.*

1. Remove right side cover.
2. Remove maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat.
4. Remove the airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

5. Disconnect the negative battery cable.
6. Remove exhaust system to provide clearance for starter removal. See appropriate EXHAUST section for your model.
7. See Figure 5-4. Pull back solenoid cable protective boot and loosen and remove hex-nut. Remove solenoid cable terminal ring (2).
8. Remove both starter mounting bolts and washers (1).
9. Remove starter from right side of motorcycle.

## INSTALLATION

1. Lubricate the starter o-ring with Harley-Davidson Special Purpose Grease, (Part No. 99857-97).
2. Install starter gear shaft into engine housing.

*NOTE*

*Be sure starter gear shaft engages the teeth of the limiter assembly in the engine housing.*

3. See Figure 5-5. Install the two starter mounting bolts and washers (1). Alternately tighten the bolts to 17.6-27.1 Nm (13-20 ft-lbs).
4. Slide solenoid cable terminal ring (2) over starter post. Thread on and tighten hex-nut to 6-10 Nm (53-88 **in-lbs**).
5. Slide protective boot securely over terminal.

**WARNING**

**Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)**

**CAUTION**

**Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)**

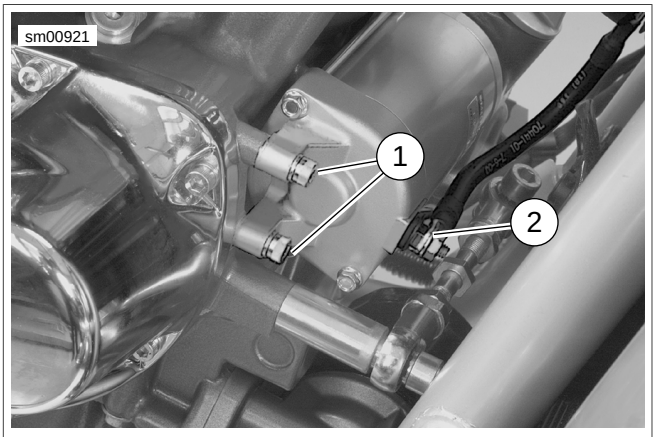
**CAUTION**

**Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)**

**WARNING**

**Be sure rubber boot covers starter solenoid terminal connected to positive (+) battery cable. An uncovered terminal can short and cause sparks, which could result in a battery explosion and death or serious injury. (00463c)**

6. Connect negative battery cable. See 1.9 BATTERY MAINTENANCE.
7. Install airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
8. Reinstall maxi-fuse and the right side cover. See 8.4 MAXI-FUSE.




1. **Starter mounting bolts and washers**
2. **Solenoid cable terminal ring**

**Figure 5-5. Starter (protective boot removed)**

## GENERAL

The starter solenoid is a switch that is designed to open and close the circuit to the electric starter motor.

## REMOVAL

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

*NOTE*

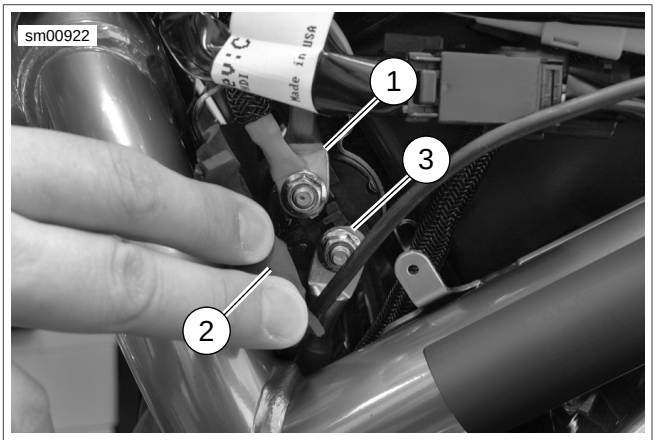
*The radiator fans are thermostatically controlled and will run will the ignition switch in the OFF position. However, pulling the maxi-fuse will disconnect power to the fans. To prevent damage to engine components, be sure the radiator has cooled before removing the maxi-fuse.*

1. Remove left and right side covers and remove maxi fuse. See 8.4 MAXI-FUSE.
2. Open rider's seat.
3. Remove the airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

4. Disconnect the negative battery cable from battery. See 1.9 BATTERY MAINTENANCE.
5. See Figure 5-6. Pull back starter cable hex-nut cover (2). Note cable locations and remove cable hex-nuts and cables.
6. Slide solenoid back and free from mounting tabs.
7. Locate paired black wire and green wire lead directly in back of solenoid and press in release square and separate connector halves and remove solenoid.




1. **Positive battery cable**
2. **Starter cable hex-nut cover**
3. **Starter cable**

**Figure 5-6. Starter Solenoid**

## INSTALLATION

1. See Figure 5-7. Mate connector halves of paired black wire and green wire leads.
2. Slide solenoid into position in plastic mounting tabs on back of battery tray.
3. Install cables in locations noted when removed.
4. Thread on and torque the hex-nuts to 6-10 Nm (53-88 **in-lbs**).
5. Mate connector halves and tuck paired wire lead up under side cover.
6. Snap top of starter cable hex-nut cover onto solenoid.

**CAUTION**

**Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)**

**CAUTION**

**Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)**

**WARNING**

**Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)**

7. Connect negative battery cable to battery. See 1.9 BATTERY MAINTENANCE.
8. Install airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

9. Reinstall the maxi-fuse and both side covers. See 8.4 MAXI-FUSE.
10. Close seat.

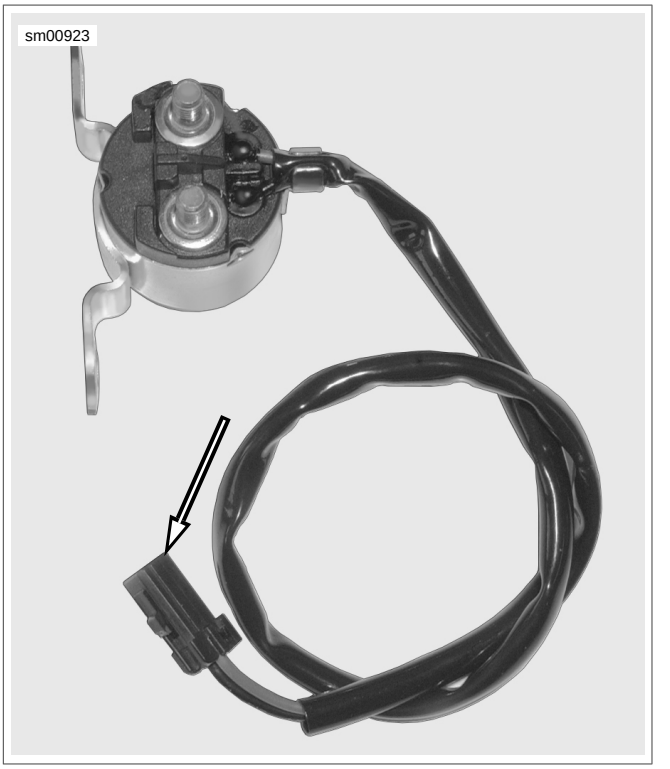



**Figure 5-7. Solenoid paired black wire and green wire lead (typical)**

# NOTES

| SUBJECT | PAGE NO. |
|---|---|
| 6.1 SPECIFICATIONS: COOLING SYSTEM | 6-1 |
| 6.2 COOLANT FLOW | 6-2 |
| 6.3 ENGINE COOLANT | 6-6 |
| 6.4 THERMOSTAT | 6-8 |
| 6.5 WATER PUMP | 6-10 |
| 6.6 COOLANT PIPES AND HOSES | 6-13 |
| 6.7 OIL LINE FITTINGS | 6-16 |
| 6.8 RADIATOR AND OIL COOLER | 6-18 |
| 6.9 OIL COOLER | 6-23 |

# NOTES

## GENERAL

**Table 6-1. Capacities**

| ITEM | LITERS | QUARTS |
|---|---|---|
| Engine coolant | 2.4 | 2.54 |
| Engine oil w/filter | 4.3 | 4.5 |

**Table 6-2. Coolant Pressure**

| ITEM | KPA | PSI |
|---|---|---|
| Cap lower limit | 96 | 14 |
| Rated cap pressure | 110 | 16 |
| Cap upper limit | 124 | 18 |
| System pressure | 103 | 15 |

**Table 6-3. Coolant Temperatures**

| ITEM | C° | F° |
|---|---|---|
| Thermostat initially opens | 85 | 185 |
| Thermostat fully open | 100 | 212 |
| Engine temperature lamp | 117 | 243 |
| Antifreeze protection | -36.7 | -34 |

**Table 6-4. Fan Operation**

| STATUS | °C | °F |
|---|---|---|
| On | 103 | 217 |
| Off | 98 | 208 |

## GENERAL

**⚠WARNING**

**Coolant mixture contains toxic chemicals, which may be fatal if swallowed. If swallowed, do not induce vomiting; call a physician immediately. Use in a well ventilated area. Irritation to skin or eyes can occur from vapors or direct contact. In case of skin or eye contact, flush thoroughly with water and go to hospital, if necessary. Dispose of used coolant according to federal, state and local regulations. (00092a)**

The VRSC engine is cooled by a an ethylene-glycol coolant and the lubricating engine oil.

The ethylene-glycol coolant is pressurized and circulated through the engine and a cooling radiator by an impeller type water pump utilizing a thermostat controlled bypass.

The coolant pressure determines the coolant boiling point. The boiling point rises as the pressure increases and drops as the pressure decreases. At the rated system pressure of 103 kPa (15 psi), the boiling point rises to over 121° C (250° F).

The engine oil also cools the engine. Specifically, an oil jet under each piston sprays a mist of oil to lower the operating temperature of that piston. See 3.4 OIL FLOW.

## FLOW DESCRIPTION

. To warm the engine up quickly, the ethylene-glycol coolant is re-circulated through the cylinders and combustion chamber in the cylinder heads. The thermostat blocks the passage to the radiator to recirculate the coolant.

As coolant exits the pump, it flows through the crankcase and around the cylinder liners removing the heat build-up caused by the motion of the piston rings. From the cylinder liners, the coolant flows up through the cylinder head and around the exhaust valves and combustion chamber. After the coolant passes around the combustion chamber, it then flows back through the closed thermostat into the pump to repeat the cycle. This flow continues until the coolant reaches 85° C (185° F) and the thermostat opens.

Once the coolant exceeds 100° C (212° F), the thermostat remains open and blocks the by-pass between the entrance and exit ports of the case.

An engine coolant temperature (ECT) sensor is mounted to the thermostat. If the temperature should exceed 117° C (243° F), the engine coolant temperature indicator on the instrument cluster will illuminate.

After the coolant leaves the cylinder heads, it flows through the radiator coolant inlet pipe (5) to the radiator. The ethylene-glycol is cooled as it flows through the radiator from left to right.

To increase the amount of air flowing through the radiator, two cooling fans will turn on when the coolant temperature exceeds 103° C (217° F) and will turn off when the temperature drops below 98° C (208° F).

The coolant exits the top right of the radiator and flows through the radiator outlet coolant pipe to the coolant pump inlet.

The pressure cap and radiator filler neck pressurize the coolant system. When the coolant pressure exceeds the pressure cap lower limit of 96 kPa (14 psi), the lower valve opens and the excess pressure and expanded coolant flow to the overflow bottle through the overflow tube. The overflow bottle is vented to the atmosphere through a long tube which loops over the top of the radiator/oil cooler assembly and down below the coolant level. When the pressure drops, the pressure cap vacuum valve opens to draw coolant back into the coolant inlet pipe from the overflow bottle.

## TROUBLESHOOTING

**⚠WARNING**

**The Troubleshooting section of this manual is a guide to diagnose problems. Read the appropriate sections of this manual before performing any work. Improper repair and/or maintenance could result in death or serious injury. (00528b)**

### Low Engine Temperature

1. Open thermostat.
2. Defective engine coolant sensor.
3. Defective cooling fan.

### High Engine Temperature

1. Stuck thermostat.
2. Blocked hoses, pipes or passages.
3. Defective cooling fan.
4. Faulty water pump.
5. Low coolant level.
6. Air in hoses, pipe or passages.
7. Defective pressure cap.
8. Defective engine coolant sensor.

### Coolant Leaks

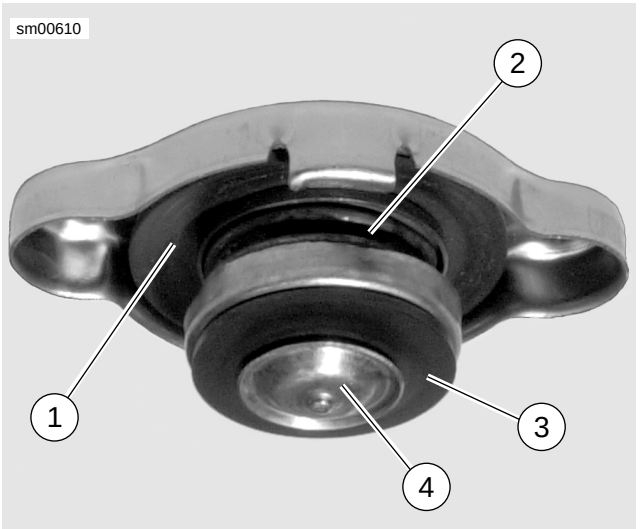
1. Damaged pressure cap gasket.
2. Faulty water pump.
3. Deteriorated o-rings on water pump.
4. Damaged engine gasket.
5. Leaking hose or hose connection.

## PRESSURE CAP

The pressure cap and radiator filler neck pressurize the coolant system. The pressure cap's upper spring diaphragm gasket seals to the upper sealing seat in the filler neck. The lower pressure limiting valve in the pressure cap seals to the lower seat. The filler neck has an overflow tube between and upper and lower sealing seat.

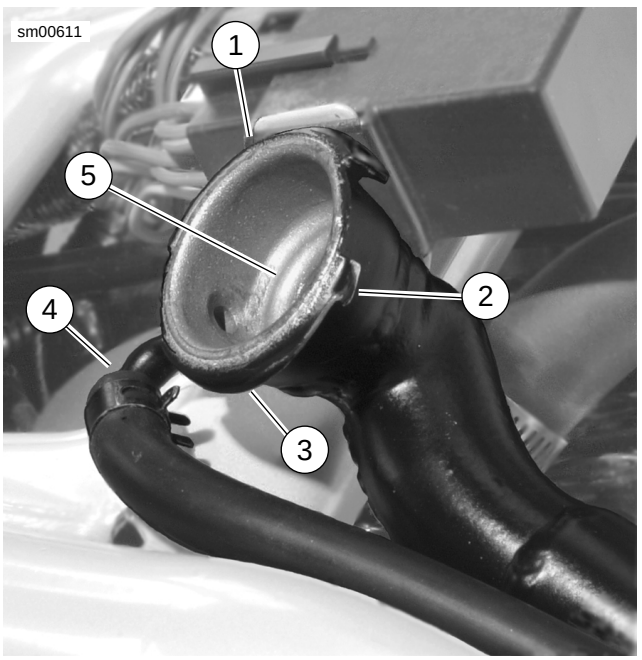
Rising pressure compresses the spring and the lower valve opens. Excess pressure and expanded coolant flow to the overflow bottle through the overflow tube. When the pressure

drops, the vacuum valve opens to draw coolant back into the radiator through the overflow tube from the overflow bottle.




1. **Upper sealing gasket**
2. **Spring diaphragm**
3. **Lower sealing gasket**
4. **Vacuum valve**

**Figure 6-1. Pressure Cap**




1. **Upper sealing seat**
2. **Safety stop**
3. **Cam**
4. **Overflow tube**
5. **Lower sealing seat**

**Figure 6-2. Filler Neck (typical)**

## PRESSURE CAP TEST

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45335 | COOLANT SYSTEM PRESSURE TESTER |

The pressure cap should be tested for the correct operating range every time the antifreeze is changed or any cooling system maintenance performed.

**⚠WARNING**

**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

1. See Figure 6-2 Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop (2). Let pressure escape. Press down and turn cap to pass over safety stops and remove.
2. Inspect cap for gasket deterioration and broken springs.
3. Turn butterfly valve parallel to boss on COOLANT SYSTEM PRESSURE TESTER (Part No. HD-45335) tester head and turn pressure cap adapter onto tester head. Turn butterfly valve perpendicular to seal tester head.

*NOTE*

*To test new caps, wet the upper sealing gasket before turning onto adapter.*

4. Turn pressure cap onto adapter. Rotate to safety stops.
5. See Figure 6-2. Pump handle to pressurize pressure limiting valve in cap. Stop pumping when pressure valve in cap opens.
6. Replace pressure cap if:
   a. Leaks below low limit, 96 kPa (14 psi).
   b. Opens above high limit, 124 kPa (18 psi).
   c. Pressure falls rapidly when pressurized within range.
7. Open butterfly valve and remove adaptor and cap.




**Figure 6-3. Pressure Cap Test**

## SYSTEM PRESSURE TEST

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45335 | COOLANT SYSTEM PRESSURE TESTER |

The cooling system can be pressure tested to identify a leak and to verify a blown engine gasket.

1. Before troubleshooting cooling system, be sure engine coolant level is at COLD FULL mark on overflow bottle when the motorcycle is on the jiffy stand.
2. Using a cloth over pressure cap, turn cap 1/4 turn counter-clockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops and remove.
3. See Figure 6-2. Clean and inspect filler neck, upper (1) and lower (5) sealing seats, overflow tube (4), and overflow bottle.

*NOTE*

*Bent filler neck cams and safety stops can cause cap to leak or affect pressure limiting valve. Replace the coolant pipe as required.*

4. See Figure 6-4. Turn butterfly valve parallel to boss on COOLANT SYSTEM PRESSURE TESTER (Part No. HD-45335) head and turn adapter onto head. Turn butterfly valve perpendicular to seal head to adapter.

*NOTE*

*Wet the upper sealing surfaces before turning adapter onto tester head.*

5. Turn double ended pressure cap onto the end of the adapter and onto filler neck. Rotate to the safety stops.

*NOTE*

*When performing the coolant system pressure test, never exceed the upper limit rating of the pressure cap. Excessive pressure can rupture cooling pipes, hoses, and radiator.*

6. Pump tester until pressure reaches 103 kPa (15 psi).
7. Refer to Table 6-5. Match movement of needle to system pressure.
8. Release pressure in system by turning butterfly pressure valve perpendicular to head. Wait until pressure is released before removing double ended cap from filler neck.

**Table 6-5. System Pressure Test**

| NEEDLE MOVEMENT | LEAK | ACTION |
|---|---|---|
| Holds steady for 2 minutes | None | None |
| Drops slowly | Small | Dye test |
| Drops quickly | Major | Visual |




**Figure 6-4. System Pressure Test (typical)**

## LEAK DETECTION DYE TEST

| PART NUMBER | TOOL NAME |
|---|---|
| HD-29545-6 | COOLANT FLUORESCENT LEAK DETECTION DYE |
| HD-35457 | BLACK LIGHT LEAK DETECTOR |

*NOTE*

*If the coolant overflow bottle is empty when the engine is cold, it is possible that air has been drawn into the coolant system. The system must be purged of any trapped air and refilled with coolant.*

1. Before troubleshooting cooling system be sure engine coolant level is at COLD FULL mark on overflow bottle when the motorcycle is on the jiffy stand.

**⚠WARNING**

**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

2. Using a cloth over pressure cap, turn cap 1/4 turn counter-clockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops of filler neck and remove.
3. If filler neck is full of coolant, remove an amount of coolant equal to the amount of dye.
4. See Figure 6-5. Pour COOLANT FLUORESCENT LEAK DETECTION DYE (Part No. HD-29545-6) into filler neck.

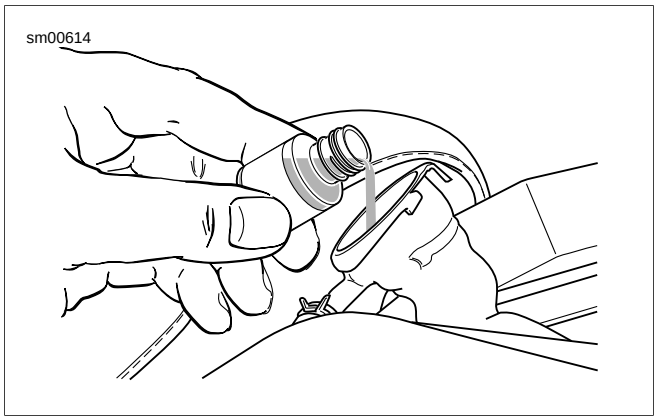



**Figure 6-5. Pouring Dye into Filler Neck**

5. Reinstall pressure cap and run engine for 10 minutes.
6. Use BLACK LIGHT LEAK DETECTOR (Part No. HD-35457) to illuminate entire cooling system. A yellow fluorescence at any spot indicates a leak.
7. Remove oil dipstick and inspect engine oil for yellow dye.

*NOTE*

*Dye in the oil may indicate a damaged engine head gasket. Draining and replacing coolant contaminated oil will be necessary as part of engine service.*

## TESTS FOR BLOWN GASKET

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45335 | COOLANT SYSTEM PRESSURE TESTER |

If a pressure test indicates a leak but there is no visible leak, even after a leak detection dye test, perform the following tests to verify a damaged engine gasket.

1. Start and run cold engine. White smoke from exhaust system indicates a blown gasket.
2. Run engine. Shut off engine.
   a. Remove oil level dipstick. Light colored foam on dipstick indicates a blown gasket.
   b. Open oil drain plug and drain a small amount of oil. Water or coolant will drain out first if gasket is blown.

*NOTES*

- *Do not allow pressure to build up past the maximum for system. If pressure rises past, turn off engine and turn butterfly pressure valve perpendicular to tester head to release pressure.*
- *Do not continue to run engine unattended with COOLANT SYSTEM PRESSURE TESTER installed. There is no safety valve with the pressure cap removed and the COOLANT SYSTEM PRESSURE TESTER installed.*

3. With COOLANT SYSTEM PRESSURE TESTER (Part No. HD-45335) installed, start cold engine and idle engine to normal operating temperature.
   a. If gauge indicates fast pressure build up, a gasket is blown.
   b. If pressure does not build up immediately, pump tester to system pressure. If gauge needle vibrates, there is a compression or combustion leak. Disconnect one spark plug at a time. The needle will stop vibrating when spark is removed from leaking cylinder.

*NOTE*

*After replacing an engine head gasket, draining and replacing contaminated oil will be necessary as part of engine service.*

## GENERAL

Genuine Harley-Davidson Extended Life Antifreeze & Coolant provides temperature protection to -36.7° C (-34° F).

GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTI-FREEZE & COOLANT is pre-diluted and ready to use full-strength. DO NOT add water. A mixture of de-ionized water and ethylene glycol-based antifreeze may be used if GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT is unavailable.

*NOTE*

*When temperatures drop below -36.7° C (-34° F), a mixture of ethylene Glycol-based Antifreeze and de-ionized water can be mixed to provided additional protection. Follow the directions on the container of un-diluted ethylene glycol to arrive at a percentage mixture that will provide protection for the anticipated temperatures.*

## REPLACING COOLANT

| PART NUMBER | TOOL NAME |
|---|---|
| HD-23688 FAHRENHEIT | BATTERY TESTER |
| HD-26568 CELSIUS | BATTERY TESTER |

**WARNING**

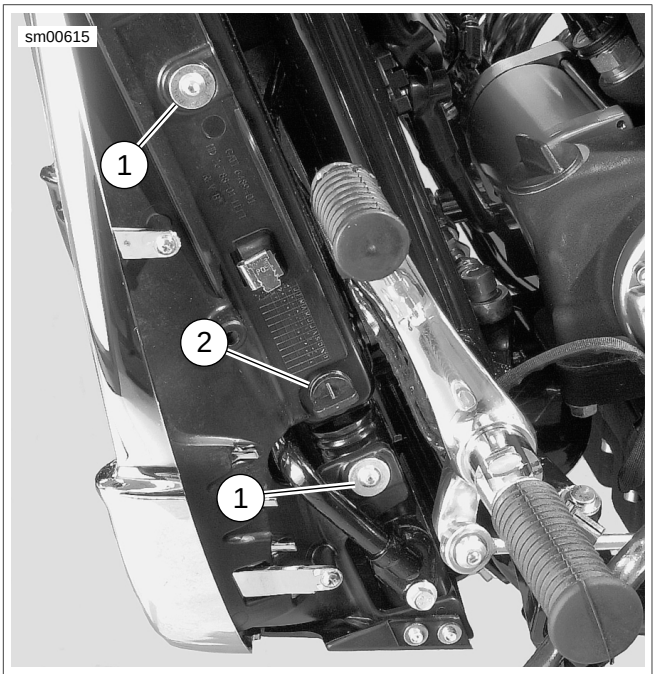
**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops and remove.
4. Use Coolant and BATTERY TESTER (Part No. HD-23688 Fahrenheit) or BATTERY TESTER (Part No. HD-26568 Celsius) to test antifreeze protection.
   a. Place a few drips of sample on prism and close cover.
   b. Hold prism up to light and read temperature scale through eye piece.

*NOTE*

*There are several scales visible in eye piece. Read only the temperature scale labeled ethylene-glycol. If the indicated temperature is less than the rated or required protection, replace the antifreeze.*

5. Remove airbox cover. Remove air filter top, and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.




1. **Radiator cover fastener and washer**
2. **Radiator drain plug**

**Figure 6-6. Radiator Left Side (cover removed) (typical) (forward controls model shown)**

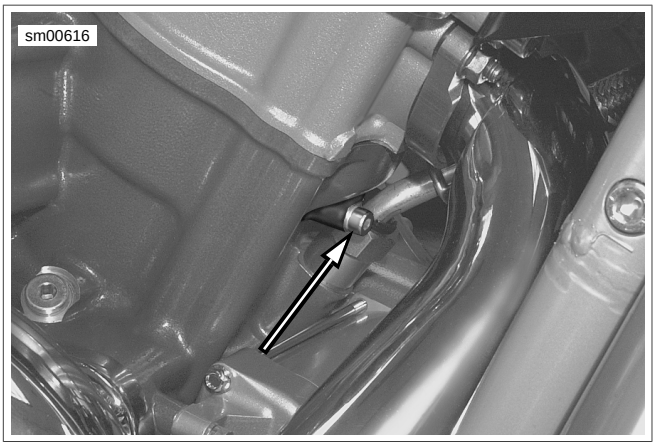



**Figure 6-7. Front Cylinder Coolant Drain Plug @ 9.7 Nm (86 in-lbs)**

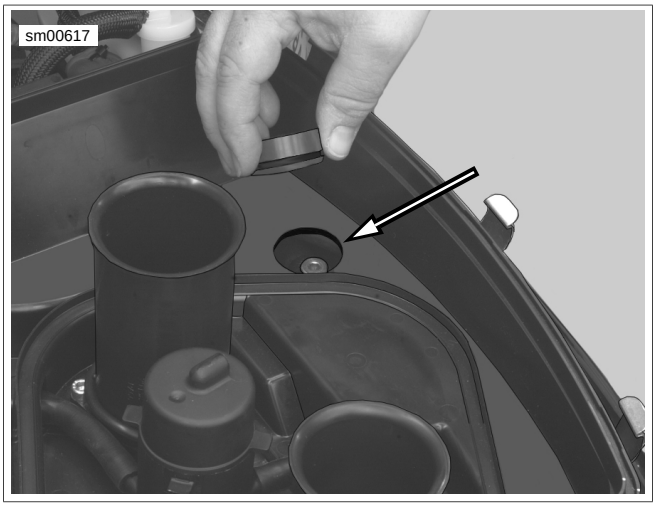



**Figure 6-8. Air Bleed Plug @ 9-11 Nm (80-97 in-lbs)**

6. See Figure 6-6. Remove left side radiator trim cover. Place a container under engine coolant radiator.
7. See Figure 6-9. Loosen but do not remove radiator drain plug. Orient radiator drain plug so that slot in threads is open to container and allow coolant to drain from the radiator.
8. Hand tighten radiator drain plug.

*NOTE*

*Locate dot on coolant drain plug. This indicates location of the drain slot is in drain plug. Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 **in-lbs**).*

9. See Figure 6-7. Place a container under engine and remove front cylinder coolant drain plug. Allow remaining coolant to drain from engine.

*NOTE*

*With the motorcycle in normal orientation, there is no need to remove the rear cylinder coolant drain plug.*

10. Install and tighten front cylinder coolant drain plug to 9.7 Nm (86 **in-lbs**).
11. Reinstall radiator trim cover.

**CAUTION**

**De-ionized water must be used with the antifreeze in the cooling system. Hard water can cause scale accumulation in water passages which reduces cooling system efficiency, leading to overheating and engine damage. (00195a)**

**WARNING**

**Coolant mixture contains toxic chemicals, which may be fatal if swallowed. If swallowed, do not induce vomiting; call a physician immediately. Use in a well ventilated area. Irritation to skin or eyes can occur from vapors or direct contact. In case of skin or eye contact, flush thoroughly with water and go to hospital, if necessary. Dispose of used coolant according to federal, state and local regulations. (00092a)**

12. See Figure 6-8. Loosen air bleed plug.
13. Through the filler neck, fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT up to lower sealing surface in filler neck.
14. Reinstall pressure cap and tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**).
15. Reinstall air filter, air filter top, and airbox cover.
16. Reinstall maxi-fuse and side cover.
17. After running engine, check coolant level in overflow bottle with coolant cold with motorcycle on jiffy stand. If level is below COLD FULL line, add antifreeze to overflow bottle until fluid level reaches COLD FULL line.
18. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.

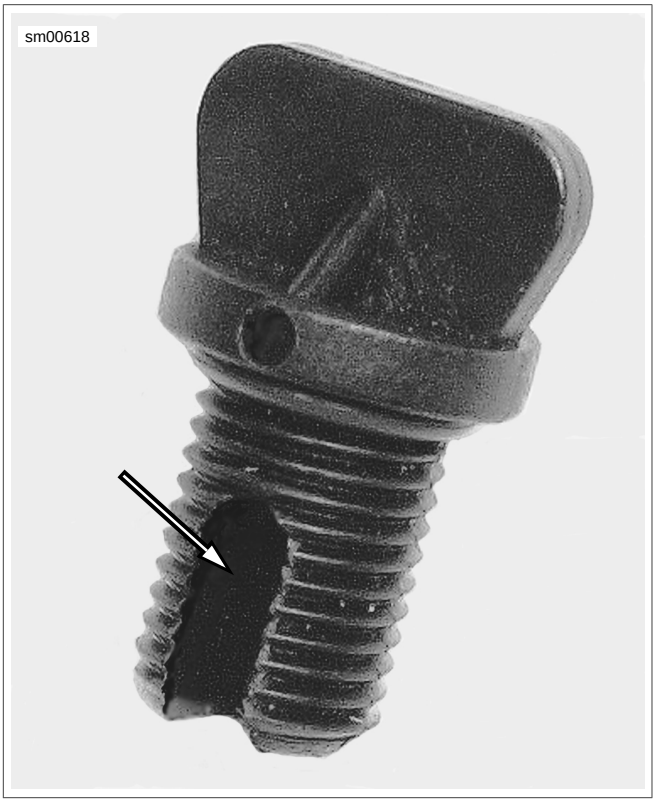



**Figure 6-9. Slot in Radiator Drain Plug**

## GENERAL

The thermostat is a valve that remains closed until the engine reaches operating temperature. When the coolant temperature exceeds 85° C (185° F), the thermostat opens allowing engine coolant to flow out of the engine to the radiator. The thermostat is fully open at 100° C (212° F).

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45307 | THERMOSTAT REMOVAL TOOL |

**⚠ WARNING**

**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

1. Allow cooling system and engine to cool.
2. Remove right side cover and maxi-fuse.
3. Open seat and remove pressure cap.
4. Remove left side radiator trim cover.
5. Loosen radiator drain plug and orient slot in drain plug to drain engine coolant into suitable container. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
6. Hand tighten radiator drain plug.

*NOTE*

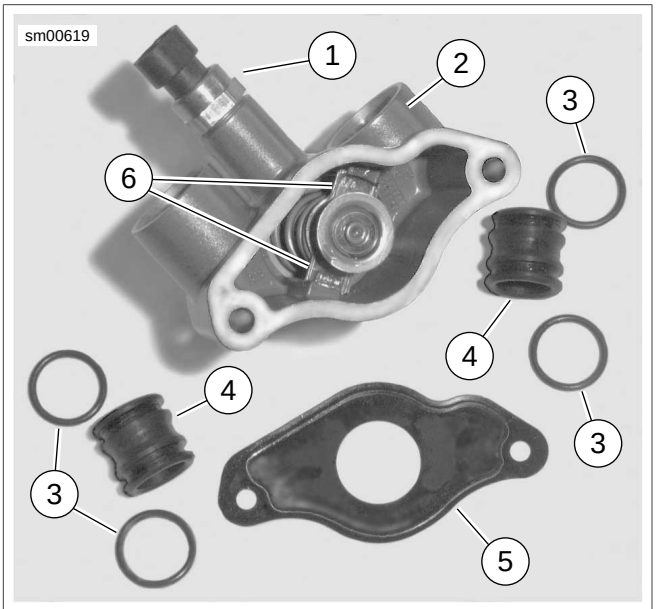
*Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 in-lbs).*

7. Remove air filter cover, air filter top, air filter, breather hose, velocity stacks, and air filter bottom. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
8. Remove pipe clamp and p-clamp from coolant pipes.
9. Loosen lower clamp on hose to engine coolant pipe. Pull coolant outlet pipe and hose up.
10. Loosen and remove fasteners and lock washers holding housing to engine case. Pull thermostat housing off engine.
11. See Figure 6-10. Disconnect coolant temperature sensor (1) from wiring harness.

*NOTE*

*See Figure 6-10. The sensor (1) for the engine coolant temperature is threaded into the engine side of the thermostat housing. When illuminated red, the engine coolant temperature indicator lamp on the instrument cluster indicates that the coolant temperature has exceeded 117° C (243° F).*

12. Pull thermostat tubes (4) and O-rings (3) out of engine.
13. See Figure 6-11. To remove thermostat from housing, engage tabs on thermostat with slots of THERMOSTAT REMOVAL TOOL (Part No. HD-45307).
14. Press on end of tool to compress thermostat spring while turning tool 90° counterclockwise (CCW). Remove thermostat.




1. **Engine coolant temperature sensor**
2. **Thermostat housing**
3. **O-ring**
4. **Thermostat tube**
5. **Gasket**
6. **Tabs**

**Figure 6-10. Thermostat and Housing**

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45307 | THERMOSTAT REMOVAL TOOL |

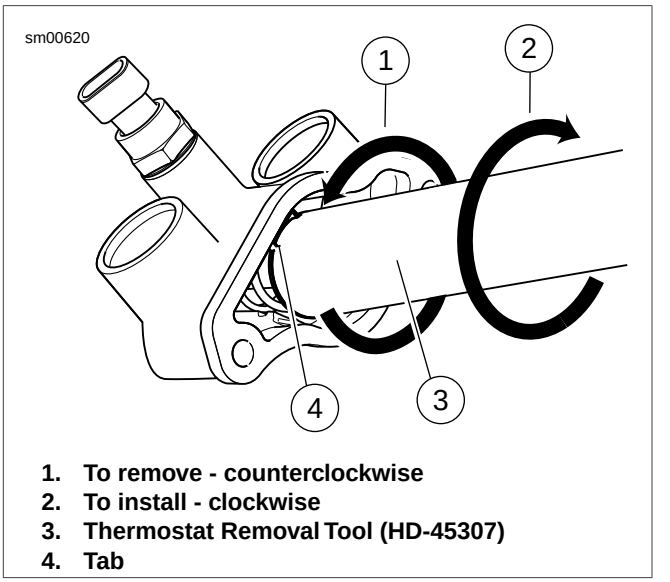
1. See Figure 6-11. To install new thermostat into housing, engage slots of THERMOSTAT REMOVAL TOOL (Part No. HD-45307) into tabs of thermostat while compressing thermostat spring. Turn tool 90° clockwise (CW) to lock thermostat into housing.

*NOTE*

*New components can be lubricated with engine coolant to ease assembly.*

2. See Figure 6-10. With **new** o-rings (3) on thermostat tubes (4), push tubes into engine case.
3. Connect engine coolant temperature sensor (1) to wiring harness.
4. Be sure lower clamp is in place on hose to engine coolant pipe.
5. Orient **new** thermostat housing gasket (5) to mating surface on engine case.
6. Push housing pipe into pipe hose and over thermostat tubes (4). Fit housing (2) to engine case.

7. Thread in housing fasteners and tighten to 9.7 Nm (86 **in-lbs**).
8. With lower hose clamp in correct orientation, tighten clamp to 3-4 Nm (27-35 **in-lbs**).
9. Install pipe clamp and p-clamp. Tighten fasteners to 6-10 Nm (53-88 ft-lbs).
10. Install air filter bottom, velocity stacks, o-rings and breather hose. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
11. Loosen air bleed plug. Remove pressure cap and fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and reinstall pressure cap.
13. Reinstall air filter, air filter top and airbox cover.
14. Reinstall maxi-fuse and side cover.
15. Rinse the motorcycle with water to remove any spilled coolant.
16. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
17. Continue to run engine, check level, and add antifreeze until coolant level remains at COLD FULL line with the motorcycle on the jiffy stand.




1. **To remove - counterclockwise**
2. **To install - clockwise**
3. **Thermostat Removal Tool (HD-45307)**
4. **Tab**

**Figure 6-11. Thermostat Removal Tool**

## REMOVAL

**⚠WARNING**

**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat and remove pressure cap.
4. Remove left side radiator trim cover.
5. Loosen and orient slot in radiator plug to drain engine coolant into suitable container.
6. Place a suitable container under engine and remove front engine coolant drain plug to drain coolant from engine.

*NOTE*

*With the motorcycle in normal orientation, there is no need to remove the rear engine coolant drain plug.*

7. Hand tighten radiator drain plug.

*NOTE*

*Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24* ***in-lbs****).*

8. Install and tighten front engine coolant drain plug to 9.7 Nm (86 **in-lbs**).
9. Reinstall left side radiator trim cover.
10. Remove airbox cover. Remove air filter top and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
11. Remove pipe clamp and p-clamp from coolant pipes. See 6.6 COOLANT PIPES AND HOSES.
12. Remove hose cover clamp from upper end of hose to coolant pipe and loosen lower hose clamp. Pull coolant pipe up.
13. See Figure 6-12. Unbolt water pump bolts and remove water pump cover.
14. Remove the insert.
15. See Figure 6-13. Using a soft mallet, tap on side of water pump to loosen.
16. See Figure 6-14. Remove bearing housing assembly with the o-rings and gasket.




**Figure 6-12. Removing Cover**




**Figure 6-13. Removing Water Pump (clutch cover removed for clarity)**

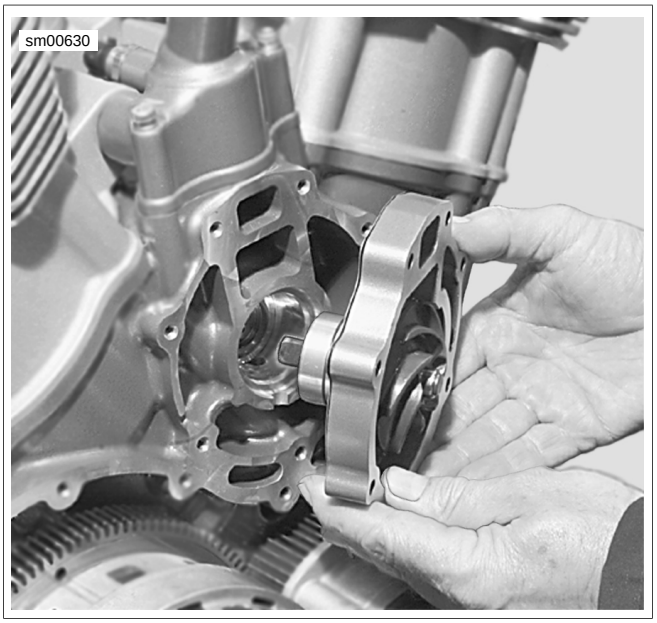



**Figure 6-14. Water Pump Bearing Housing Assembly (clutch cover removed for clarity)**

## INSTALLATION

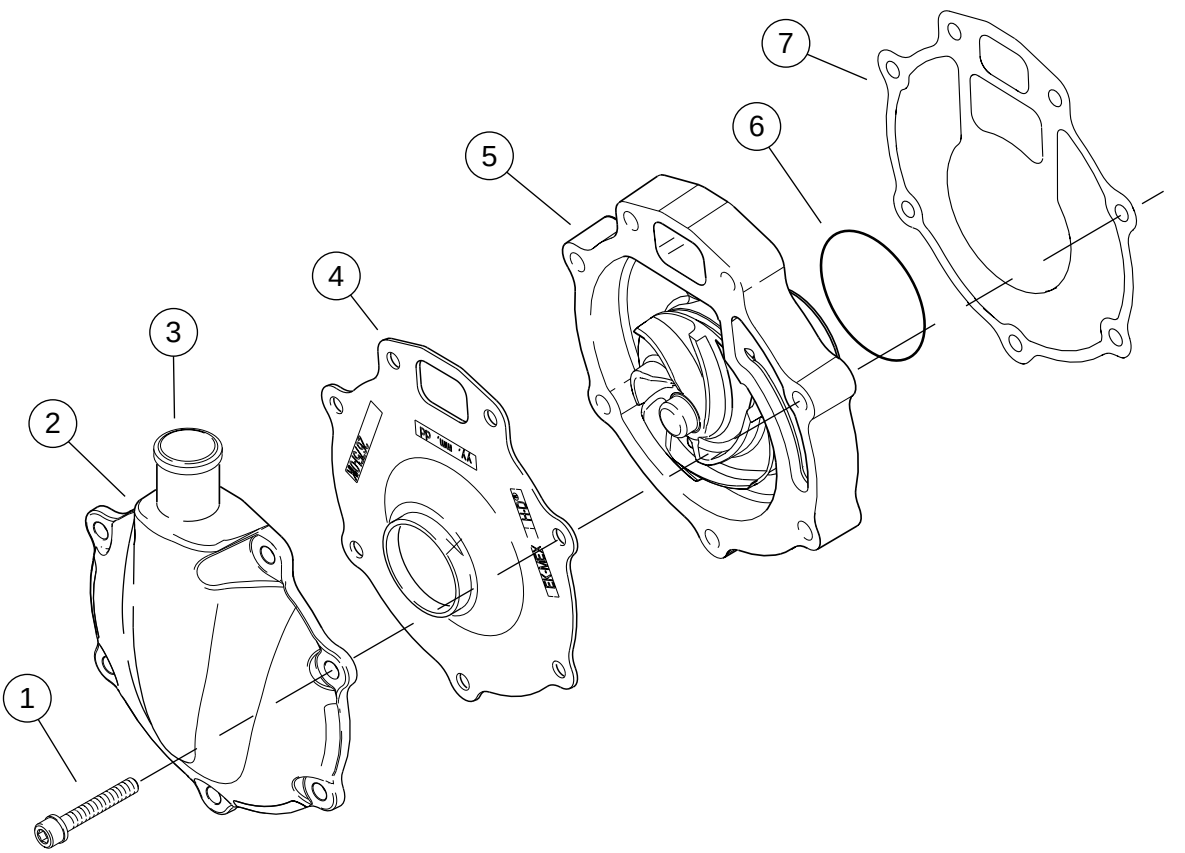
1. Clean engine cavity.
2. See Figure 6-15. Lube and install **new** o-ring (6) on bearing housing assembly (5).
3. Install **new** gasket (7) with part numbers facing away from engine block.
4. Align pump square drive with drive shaft and push water pump into engine cavity.

*NOTE*

*A lubricant, such as tire soap or detergent and water, can be used to lubricate the hose to aid in pushing hose over neck beads.*

5. Thread on mounting bolts (1) holding bearing housing assembly (5), water pump insert (4) and water pump cover (2) over water pump cavity.
6. Tighten water pump mounting bolts to 9.7 Nm (86 **in-lbs**).
7. Push pump to engine coolant pipe hose on cover outlet pipe (3).
8. Install lower bright hose clamp and tighten to 3-4 Nm (27-35 **in-lbs**).
9. Install and tighten hose cover to 3-4 Nm (27-35 **in-lbs**).
10. Install pipe clamp and p-clamp. See 6.6 COOLANT PIPES AND HOSES.
11. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON LIFE ANTIFREEZE & COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and reinstall pressure cap.
13. Install maxi-fuse and right side cover.
14. Rinse motorcycle with water to remove any spilled coolant.
15. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
16. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.

sm00646




1. **Mounting bolt @ 9.7 Nm (86 in-lbs)**
2. **Water pump cover**
3. **Cover outlet pipe**
4. **Water pump insert**
5. **Bearing housing assembly**
6. **O-ring (2)**
7. **Gasket**

**Figure 6-15. Water Pump**

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| SNAP-ON SDD1410 | SCREWDRIVER |

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

3. Remove the negative battery cable.

**⚠WARNING**

**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

4. Open seat and remove pressure cap.
5. Remove left side radiator trim cover. Remove radiator plug and drain engine coolant into suitable container.
6. Remove air filter top, air filter, breather hose, velocity stacks and air filter bottom. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
7. See Figure 6-16. Loosen pipe clamp (4). Loosen and remove fastener (7) holding p-clamp (8) to engine.
8. Squeeze clamp (15) and pull off end of overflow hose at overflow bottle. Pull drain hose to radiator/oil cooler off overflow bottle. Remove overflow bottle.
9. Loosen clamps (12, 17) on bottom of hoses to water pump and thermostat.
10. Use a long thin SCREWDRIVER (Part No. Snap-on SDD1410) to loosen clamps (12) and pull hoses (10, 13) off radiator.
11. Remove engine coolant pipes (2, 3) with hoses (10, 13, 14, 19, and 21).

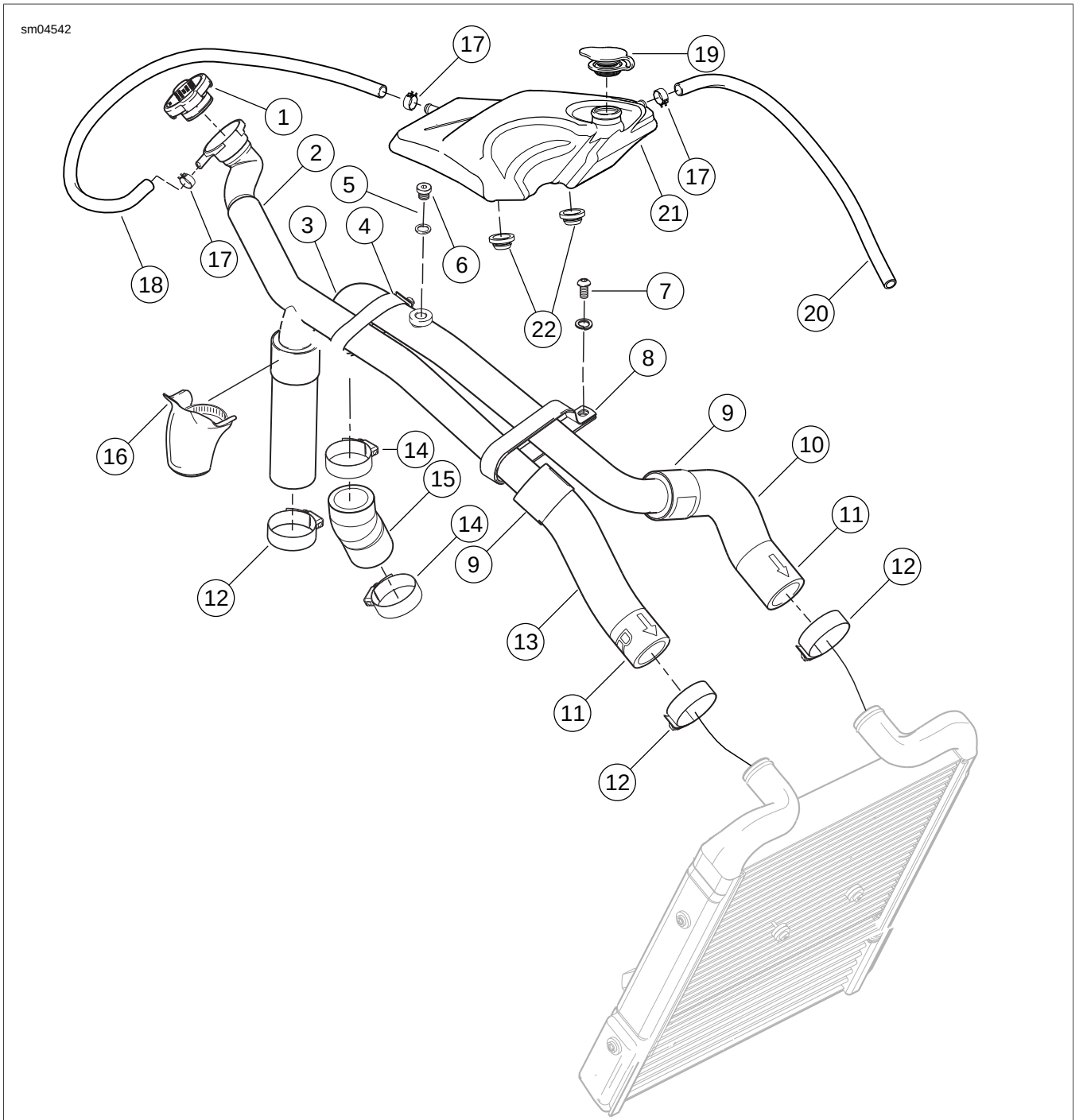
## DISASSEMBLY

1. See Figure 6-16. Cut shrink clamps (9) from the coolant inlet and the coolant outlet pipes (2, 3) and hoses (10, 13, 19).

*NOTE*

*To remove shrink clamps without cutting, use a soldering iron and, carefully, melt a slice through the band without damaging the hose.*

2. Loosen overflow hose clamp (15) and remove overflow hose (21) from filler neck.
3. Remove hose cover (20) and loosen upper clamp (12) from the water pump to coolant inlet pipe hose.
4. Clean hose mounting stems on the engine coolant inlet pipe (2) and the engine coolant outlet pipe (3) with a wire brush.
5. Inspect all components and replace as required.




1. **Pressure cap**
2. **Coolant inlet pipe**
3. **Coolant outlet pipe**
4. **Pipe clamp**
5. **Air bleed plug**
6. **Seal**
7. **Fastener and washer**
8. **P-clamp**
9. **Shrink clamp (2)**
10. **Hose (engine coolant outlet pipe to radiator)**
11. **Embossed arrow - top and front**
12. **Clamp - bright**
13. **Hose - coolant inlet pipe to radiator**
14. **Clamp - black (2)**
15. **Hose**
16. **Hose cover**
17. **Clamp - overflow hose**
18. **Overflow hose**
19. **Cap**
20. **Breather hose**
21. **Coolant bottle**
22. **Coolant bottle to frame mounting grommets**

**Figure 6-16. Coolant pipes, hoses and overflow bottle**

## ASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-25070 | ROBINAIR HEAT GUN |

1. See Figure 6-16. If removed, thread the air bleed plug (5) with **new** seal (6) into the coolant outlet pipe (3).
2. Remove **new** shrink clamp (9) from packaging brace by squeezing band to collapse, then fold in half and remove from cardboard. Slide shrink clamps over hoses.
3. Orient radiator hoses with embossed arrow (11) on top and towards front. Push hose over fitting beads on coolant inlet and coolant outlet pipes (2, 3).
4. Orient shrink clamps (9) so print on the clamp is visible after shrinking. Slide clamp over end of hose to overlap the bulge formed by fitting bead of coolant pipe.

*NOTE*

*Do NOT use open flame to shrink clamp. Using an open flame could result in uncontrolled melting of clamp.*

5. Using a ROBINAIR HEAT GUN (Part No. HD-25070) or similar tool, apply heat to shrink clamps (9). Move heat tool around clamp continuously to prevent burning.

*NOTE*

*Heated area must cover at least 1/3 of clamp surface. If heating shrink clamp while hose and pipe are still mounted in motorcycle, take care not to damage surrounding components.*

6. Heat until shrink wrap contracts and remove heat..

*NOTE*

*Check seal by trying to rotate hose on fitting by hand. Hose and clamp should NOT turn when using reasonable torque.*

7. Repeat for each shrink clamp required.

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| SNAP-ON SDD1410 | SCREWDRIVER |

1. See Figure 6-16. With upper black clamp (17) on hose (18) and lower black clamp (17) loose, install coolant outlet pipe (3).
2. With embossed arrow (11) pointing towards front and on top, push hose (10) over neck bead of radiator inlet neck. Push hose (19) onto outlet neck of thermostat housing.

*NOTE*

*A lubricant, such as tire soap or detergent and water, can be used to lubricate the hose to aid in pushing hose over neck beads.*

*When checking coolant level, motorcycle is checked on jiffy stand.*

3. With hose cover (20), clamp (17), and bright clamp (12) loose on hose, install coolant inlet pipe (2).
4. With embossed arrow (11) pointing towards front and on top, push hose (13) over neck bead of radiator outlet and push hose (20) over water pump inlet neck.
5. Use a long thin SCREWDRIVER (Part No. SNAP-ON SDD1410) to tighten clamps (12, 18) to 3-4 Nm (27-35 **in-lbs**).
6. Install p-clamp (8) and pipe clamp (4) over both pipes. Tighten pipe clamp (4) to 6.5 Nm (57 **in-lbs**) and tighten p-clamp to 6-10 Nm (53-88 **in-lbs**).
7. Install overflow bottle with overflow hose and cap (14) to grommets on frame).
8. Install and clamp overflow hose to filler neck and overflow bottle.
9. Pressure test to 103 kPa (15 psi).
10. Install air filter bottom, velocity stacks, O-rings, and breather hose. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
11. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and reinstall pressure cap.
13. Reinstall the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
14. Install air filter, air filter top and airbox cover.
15. Install right side cover and maxi-fuse.
16. Rinse motorcycle with water to remove any spilled coolant.
17. After running engine, check coolant level in overflow bottle with coolant cold. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
18. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line.

## GENERAL

Oil flows into engine at crankcase fitting. Oil flows out out of engine at oil filter fitting.

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-46503 | OIL LINE REMOVER |

**⚠WARNING**

**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse.

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

3. Remove negative battery cable.
4. Snap the plastic dust cap from the quick connect oil line fitting at the crankcase (oil in) and slide it up the oil pipe.

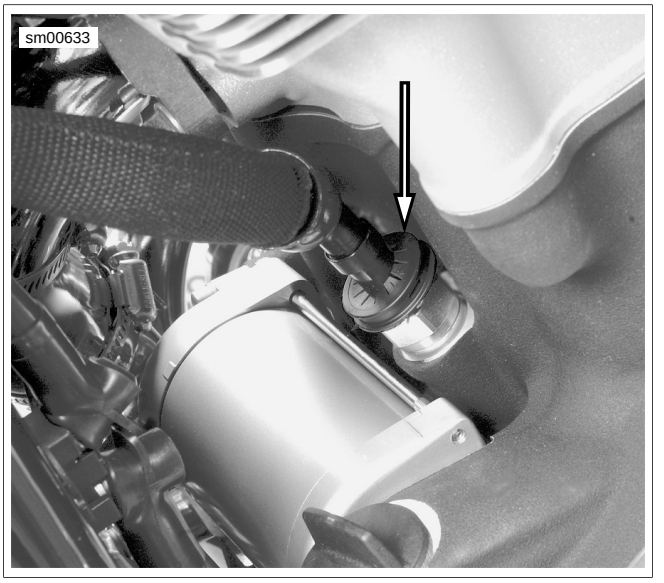



**Figure 6-17. Crankcase Oil Line (oil in) Fitting**

5. See Figure 6-18. Close the OIL LINE REMOVER (Part No. HD-46503) over the oil line. Match the notches in the tool flange to the U-bends in the spring clip.
6. See Figure 6-19. Rotate the tool to expand the spring clip out of the groove in the oil fitting.
7. With a cup under the fitting, use finger and thumb to hold the OIL LINE REMOVER (Part No. HD-46503) squarely against the fitting to keep the spring clip expanded. Use only enough pressure to hold the tool square. Excess pressure will prevent simultaneously pulling the line and tool from the fitting.
8. Pull the oil line and the tool from the fitting.
9. Repeat to remove the oil line from the remaining oil line fitting.
10. Remove oil line fittings and plug the holes until they can be replaced.
11. Remove radiator/oil cooler assembly. See 6.8 RADIATOR AND OIL COOLER.
12. Supporting the radiator/oil cooler assembly, pull the assembly far enough forward to access the oil filter (oil out) fitting.
13. Snap the plastic dust cap from the quick connect oil line fitting at the oil filter.
14. Use the OIL LINE REMOVER (Part No. HD-46503) to remove the oil line from the fitting.
15. Remove the radiator/oil cooler assembly.




**Figure 6-18. Oil Line Remover**




**Figure 6-19. Oil Line Fitting with Spring Clip**

## INSTALLATION

1. Install oil line fittings with o-ring into crankcase (oil in) and oil filter mount (oil out). Tighten to 40-44 Nm (29-32 ft-lbs).
2. See Figure 6-20. Supporting the radiator/oil cooler assembly, push the flanged oil line into the oil filter (oil out) fitting until it clicks in place under the spring clip.
3. Snap the plastic dust cap over the spring clip groove.
4. Install the radiator/oil cooler assembly. See 6.8 RADIATOR AND OIL COOLER.
5. Push the flanged oil line into the crankcase (oil in) fitting until it clicks in place under the spring clip.

*NOTE*

*Yellow witness band on the flanged oil line will not be visible if the oil line has been correctly snapped into the fitting.*

6. Snap the plastic dust cap over the spring clip groove.

*NOTE*

*Dust cap will not snap onto fitting if the oil line is not correctly installed on fitting.*

7. Lightly tug on oil line to verify that it is securely locked to fitting.
8. Check oil level and add oil if required.
9. Reinstall the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
10. Install maxi-fuse and right side cover.
11. After running engine,
    a. Inspect oil fittings for oil leaks.
    b. Check oil level and add oil if required.
    c. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand. See 1.7 COOLING SYSTEM.




**Figure 6-20. Flanged Oil Line**

## GENERAL

The heat exchangers, or radiators, for both engine cooling and oil cooling are bolted together in a single radiator/oil cooler assembly. The radiator/oil cooler assembly is fasten to the frame with:

- Double threaded studs near the steering head.
- Two pins and rubber grommets on the bottom of the oil cooler that fit the frame cross member.

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-46503 | OIL LINE REMOVER |
| SNAP-ON SDD1410 | LONG THIN SCREWDRIVER |

**⚠ WARNING**

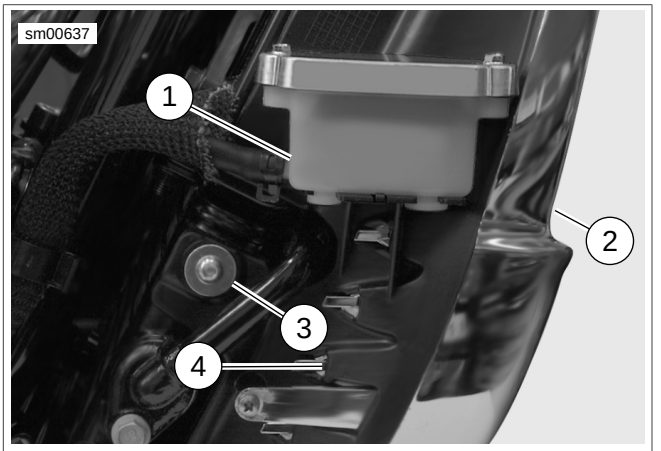
**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.

**⚠ WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

3. Remove negative battery cable.
4. Remove airbox decorative cover, airbox cover, air filter cover and air filter. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
5. See Figure 6-23. Remove fastener and right radiator trim cover.
6. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.




1. **Rear brake master cylinder reservoir**
2. **Chrome inlet bezel**
3. **Fastener and washer**
4. **Radiator cover**

**Figure 6-21. Right Side Radiator**

7. See Figure 6-23. Remove fastener and left radiator trim cover.

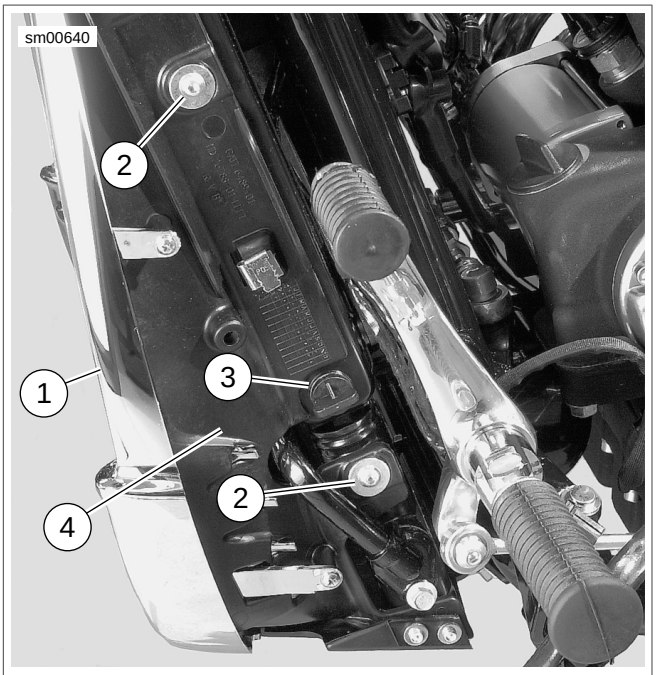
*NOTE*

*Before removing wiring harnesses, carefully note wire routing. In particular, pay close attention to locations of cable wraps that must be replaced.*

8. Clip cable wrap tying cooling fan wire harness to crankshaft position sensor (CKP) harness.
9. Push straight down to remove stator to regulator connector [46] from metal clip on side of radiator cover.
10. Push connectors and wire harnesses away from coolant drain plug up and behind shift lever.
11. Place a container under left side of radiator.




**Figure 6-22. Dot on Coolant Drain Plug**




1. **Chrome inlet bezel**
2. **Fastener and washer**
3. **Coolant drain plug**
4. **Radiator cover**

**Figure 6-23. Left Side Radiator (typical) (forward controls model shown)**

*NOTE*

*Locate dot on coolant drain plug. This indicates location of the drain slot in drain plug.*

12. See Figure 6-23. Loosen but do not remove coolant drain plug (3). Turn drain plug until slot in threads drains into container.
13. Open seat and remove pressure cap to accelerate coolant drain from radiator.
14. Hand tighten coolant drain plug. See 6.3 ENGINE COOLANT.
15. Place a container under engine, remove oil filler plug/dipstick, and oil drain plug and drain oil. Reinstall dipstick and drain plug. See 1.8 ENGINE OIL AND FILTER.
16. Separate stator to regulator connector [46].
17. Remove top cooling fan connector [97T] from radiator cover by rocking first one way and with a finger pull the connector tab to compress butterfly peg.
18. Separate top cooling fan wiring harness connector [97T] and bottom cooling fan connector [97B].
19. Separate crank position sensor connector [79].
20. Cover front fender with shop towel or protective cover. Remove fasteners and washers on each side of radiator cover. Remove radiator cover with chrome inlet bezels attached.

*NOTE*

*Both the oil line lines to the oil cooler remain fastened to the radiator/oil cooler assembly. The drain hose from the expansion bottle also remains clipped to the assembly.*

21. Use a LONG THIN SCREWDRIVER (Part No. SNAP-ON SDD1410) to loosen worm drive clamps on both engine coolant hoses at radiator.
22. Disconnect the end of drain hose from the overflow bottle.
23. See Figure 6-24. Loosen but do not remove nuts holding assembly to front engine mount studs.
24. Remove fasteners under radiator assembly that hold cross member to frame. Gently pull bottom of radiator/oil cooler assembly forward.
25. Snap the plastic dust cap from the quick connect oil line fitting at the oil filter (oil out).
26. See Figure 6-18. Close the OIL LINE REMOVER (Part No. HD-46503) over the oil line. Match the notches in the tool flange to the U-bends in the spring clip.
27. See Figure 6-19. Holding the oil line in the palm of the hand, rotate the tool to expand the spring clip out of the groove in the oil fitting.
28. With a cup under the fitting, use finger and thumb to hold the OIL LINE REMOVER (Part No. HD-46503) squarely against the fitting to keep the spring clip expanded. Use only enough pressure to hold the tool square. Excess pressure will prevent pulling the line and tool from the fitting simultaneously.
29. Pull the oil line and the tool from the fitting.

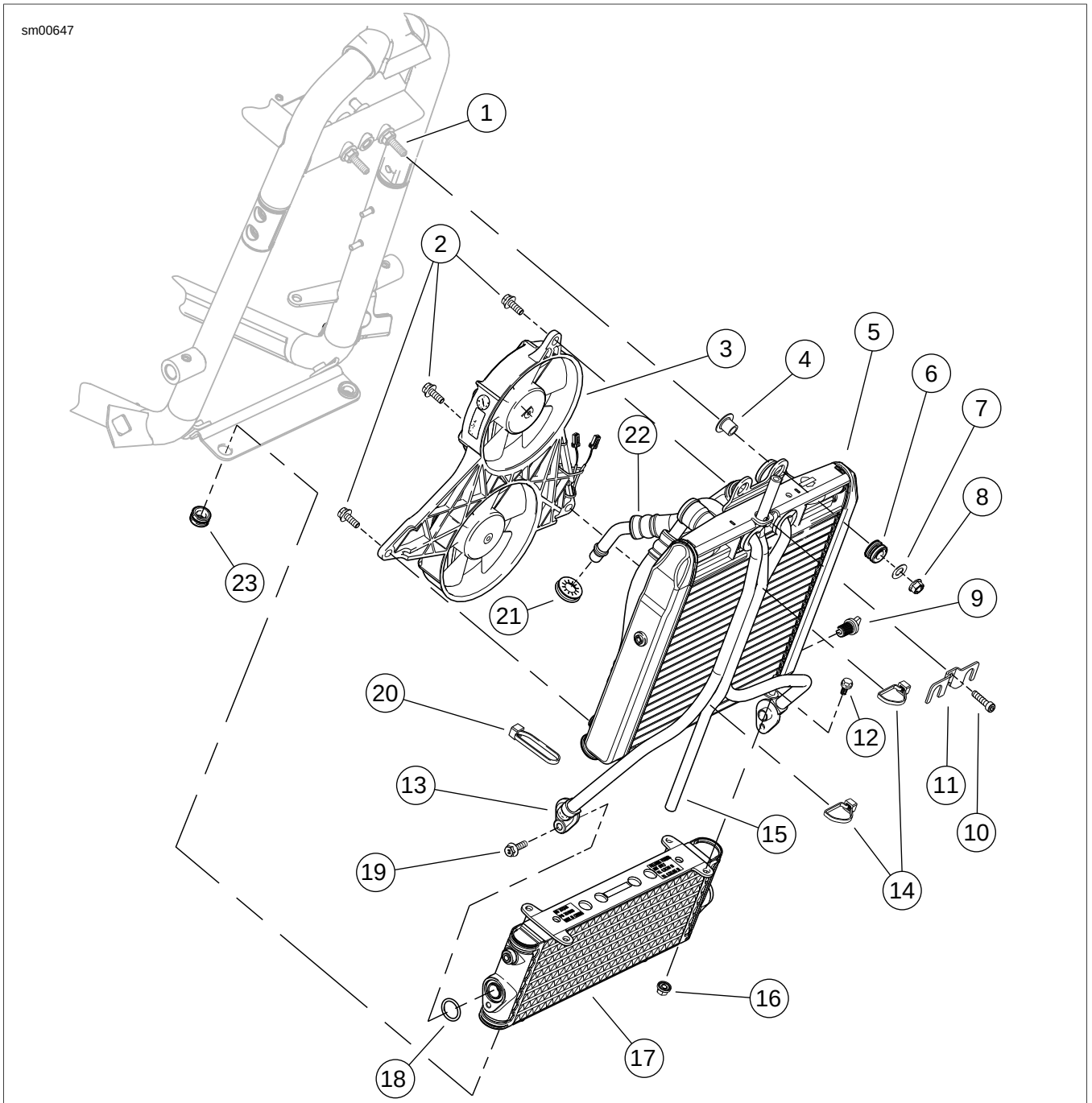
30. Repeat to remove the oil line from the crankcase (oil in) oil line fitting. See 6.7 OIL LINE FITTINGS.
31. Remove nuts holding radiator assembly to engine mount studs and remove radiator/oil cooler assembly.
32. Retain bushings, grommets and washers.

## INSTALLATION

**CAUTION**

**Clean the inlet surface of the radiator regularly. Leaves and other debris can collect on the radiator surface and degrade radiator performance which could lead to engine overheating and engine damage. (00197c)**

1. Cover front fender with a shop towel or protective cover.
2. Hold radiator/oil cooler assembly up to frame.
3. Line up and fit inlet and outlet pipes to radiator hoses.
4. Push oil line into oil out fitting on oil filter. Snap plastic ring around spring clip groove on fitting. See 6.7 OIL LINE FITTINGS.
5. Thread on but do not tighten nuts holding radiator/oil cooler assembly to engine mount studs.
6. Push oil line into oil in fitting on crankcase. Snap plastic ring around spring clip groove on fitting. See 6.7 OIL LINE FITTINGS.
7. See Figure 6-24. Slip grommets (23) into cross member on frame. Install radiator into cross member on frame.
8. Tighten cooling system fasteners to following:
   a. Cross member fasteners to 20-26 Nm (15-19 ft-lbs).
   b. Top mounting nuts (8) to 19-27 Nm (14-20 ft-lbs).
   c. Pipe clamp to 6.5 Nm (57 **in-lbs**).
   d. P-clamp to 6-10 Nm (53-88 **in-lbs**).
   e. Hose clamps to 3-4 Nm (27-35 **in-lbs**).
9. Route overflow hose (15) to overflow bottle.
10. Install radiator cover.




1. **Engine mount stud**
2. **Cooling fan assembly fasteners**
3. **Cooling fan assembly**
4. **Bushing**
5. **Radiator**
6. **Grommet**
7. **Washer**
8. **Nut**
9. **Engine coolant drain plug**
10. **Bolt**
11. **Radiator oil line bracket**
12. **Fastener**
13. **Oil line manifold**
14. **Cable wrap**
15. **Overflow hose**
16. **Nut**
17. **Oil cooler**
18. **Oil line manifold o-ring**
19. **Fastener**
20. **Cable wrap - through oil cooler**
21. **Plastic dust cap**
22. **Oil line**
23. **Grommet**

**Figure 6-24. Radiator/Oil Cooler Assembly (typical)**

11. Mate:
    a. Crank position sensor connector [79] halves.
    b. Top and bottom cooling fan connector [97T], [97B] halves.
    c. Stator to voltage regulator connector [46] halves.
12. Push top fan connector [97T] into radiator cover.
13. Cable wrap fan wiring harness to crank position sensor wiring harness and mounting both through frame clip.
14. Install left and right side radiator covers.
15. Fill engine with oil. See 1.8 ENGINE OIL AND FILTER.
16. Install air filter bottom, velocity stacks, o-rings and breather hose. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
17. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck. See 6.3 ENGINE COOLANT.
18. Tighten air bleed plug to 9-11 Nm (80-97 i**n-lbs**) and reinstall pressure cap.
19. Install air filter, air filter top and air filter cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**⚠WARNING**

**Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)**

**CAUTION**

**Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)**

**CAUTION**

**Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)**

20. Reinstall the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
21. Install right side cover and maxi-fuse.
22. After running engine, inspect oil fittings for oil leaks. Check oil level and add oil if required.
23. After running engine, check coolant level in overflow bottle with coolant cold with motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
24. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.

## REMOVAL

**WARNING**

**Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)**

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

3. Remove negative battery cable.
4. Remove oil lines from oil fittings. See 6.7 OIL LINE FITTINGS.
5. Remove the radiator/oil cooler assembly. See 6.8 RADIATOR AND OIL COOLER.
6. See Figure 6-24. With assembly on bench and holding a cup under each line, remove the fasteners holding oil line manifolds to oil cooler. Discard o-rings.
7. If replacing oil lines:
   a. Remove oil line bracket fastener and bracket with spacers bushings, grommets and washers.
   b. Cut cable wraps around drain hose and oil lines.
   c. Remove drain hose and oil cooler outlet and inlet pipes.
8. Cut cable wrap holding expansion bottle drain hose to oil cooler.
9. Remove fasteners holding oil cooler to engine coolant radiator. Remove oil cooler.

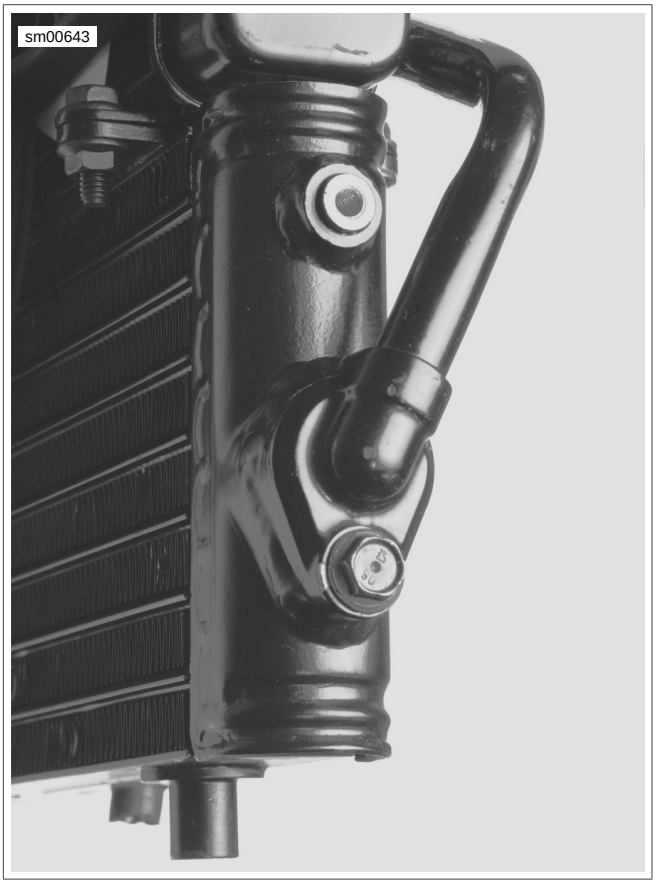



**Figure 6-25. Oil Line Manifold**

## INSTALLATION

1. See Figure 6-26. Install oil cooler to engine coolant radiator. Tighten front and rear fasteners (4) to 10-12 Nm (89-106 **in-lbs**).
2. If installing oil pipes:
   a. Route oil pipes in front and over top of engine coolant radiator.
   b. Install radiator oil line bracket (2) over the oil lines and tighten fastener to 8-10 Nm (71-88 **in-lbs**).
   c. Install new o-rings in the oil cooler ports.
   d. Install fasteners holding oil line manifolds to oil cooler. Tighten to 8-10 Nm (71-88 **in-lbs**).
   e. Route drain hose (1) on centerline of oil cooler.

*NOTE*

*Incorrect routing of drain hose may cause interference with radiator cover.*

f. Cable wrap (5) oil lines (7, 3) and drain hose (1) to coolant radiator at upper and lower points on straight portion prior to bend in lines.

g. Cable wrap end of drain hose through oil cooler cooling fins (6).

h. See Figure 6-24. Install spacer, bushings grommet, and washers to radiator/oil cooler assembly mounting bracket.

3. Install the radiator/oil cooler assembly. See 6.8 RADIATOR AND OIL COOLER.

**⚠WARNING**

**Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)**

**CAUTION**

**Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)**

**CAUTION**

**Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)**

4. Install the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).

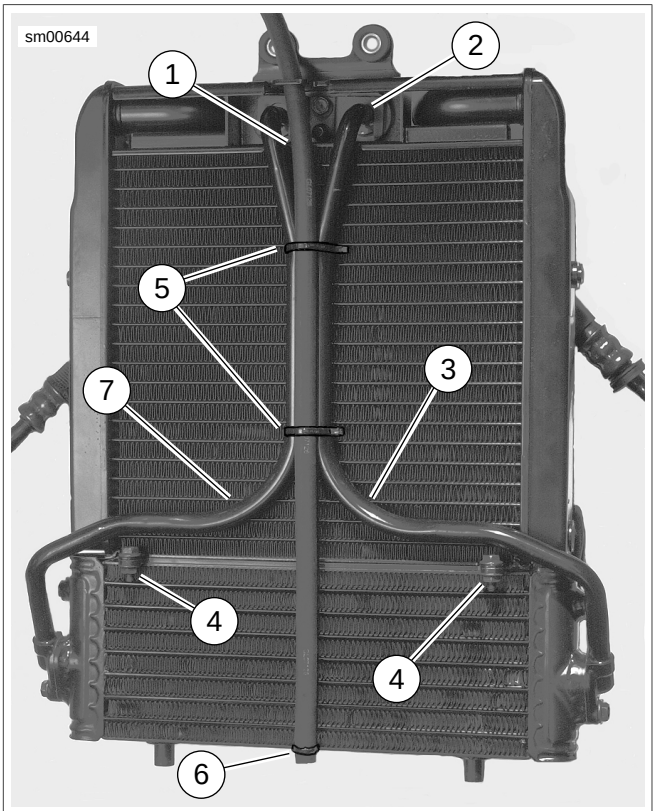
5. Install maxi-fuse and right side cover.

6. After running engine:

a. Inspect oil pipes and fittings for oil leaks.

b. Check oil level and add oil if required.

c. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand and add coolant if required.




1. **Drain hose**
2. **Oil line bracket**
3. **Oil line to crankcase**
4. **Oil cooler to radiator fasteners @ 10-12 Nm (89-106 in-lbs)**
5. **Cable wrap**
6. **Cable wrap through cooling fins**
7. **Oil line from oil filter**

**Figure 6-26. Radiator and Oil Cooler Assembly**

**SUBJECT** **PAGE NO.**
7.1 SPECIFICATIONS: TRANSMISSION....7-1
7.2 CLUTCH....7-2
7.3 TRANSMISSION....7-13
7.4 COUNTERBALANCER BEARING REPLACEMENT....7-25
7.5 SHIFT SHAFT AND SEAL....7-32
7.6 OUTPUT SHAFT....7-34
7.7 INPUT SHAFT....7-44

# NOTES

## GENERAL

**Table 7-1. Primary Gearing**

| ENGINE OUTPUT | TRANSMISSION INPUT | RATIO |
|---|---|---|
| 64 | 117 | 1.828 |

**Table 7-2. Transmission Gearing**

| GEAR | INPUT | OUTPUT | RATIO |
|---|---|---|---|
| 1st | 18 | 45 | 2.500 |
| 2nd | 25 | 42 | 1.680 |
| 3rd | 29 | 39 | 1.345 |
| 4th | 31 | 36 | 1.161 |
| 5th | 25 | 26 | 1.040 |

**Table 7-3. Secondary Gearing**

| TRANSMISSION OUTPUT | REAR WHEEL | RATIO |
|---|---|---|
| 30 (HDI) | 72 | 2.4 |
| 28 (DOM) | 72 | 2.571 |

**Table 7-4. Gear Ratios: 2008 VRSC Models**

| GEAR | DOMESTIC | INTERNATIONAL |
|---|---|---|
| 1st gear | 11.752 | 10.969 |
| 2nd gear | 7.898 | 7.371 |
| 3rd gear | 6.322 | 5.900 |
| 4th gear | 5.459 | 5.095 |
| 5th gear | 4.889 | 4.563 |

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-48625 | CLUTCH HUB HOLDER |
| HD-48625 | CLUTCH HUB HOLDER |
| HD-8008M | CLUTCH HUB NUT |

1. See Figure 7-1. If engine is in chassis, remove secondary clutch actuator cover.
2. Remove three fasteners on secondary clutch actuator and remove from clutch housing. Wrap clutch actuation cylinder with shop towel and secure away from engine.
3. See Figure 7-2. Loosen and remove clutch side crankcase cover fasteners in reverse order of torque sequence.
4. Remove clutch side crankcase cover.

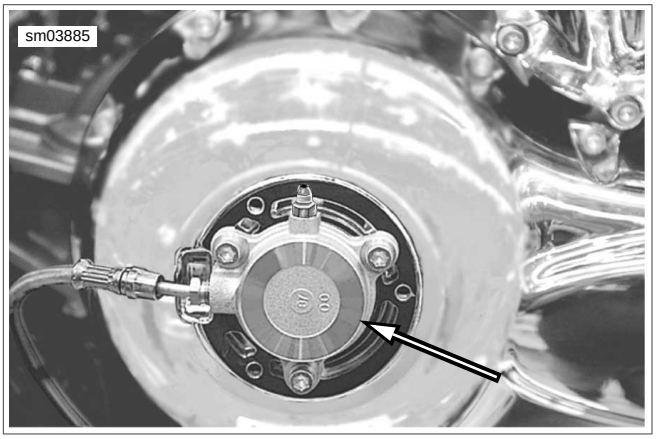



**Figure 7-1. Secondary Clutch Actuator**

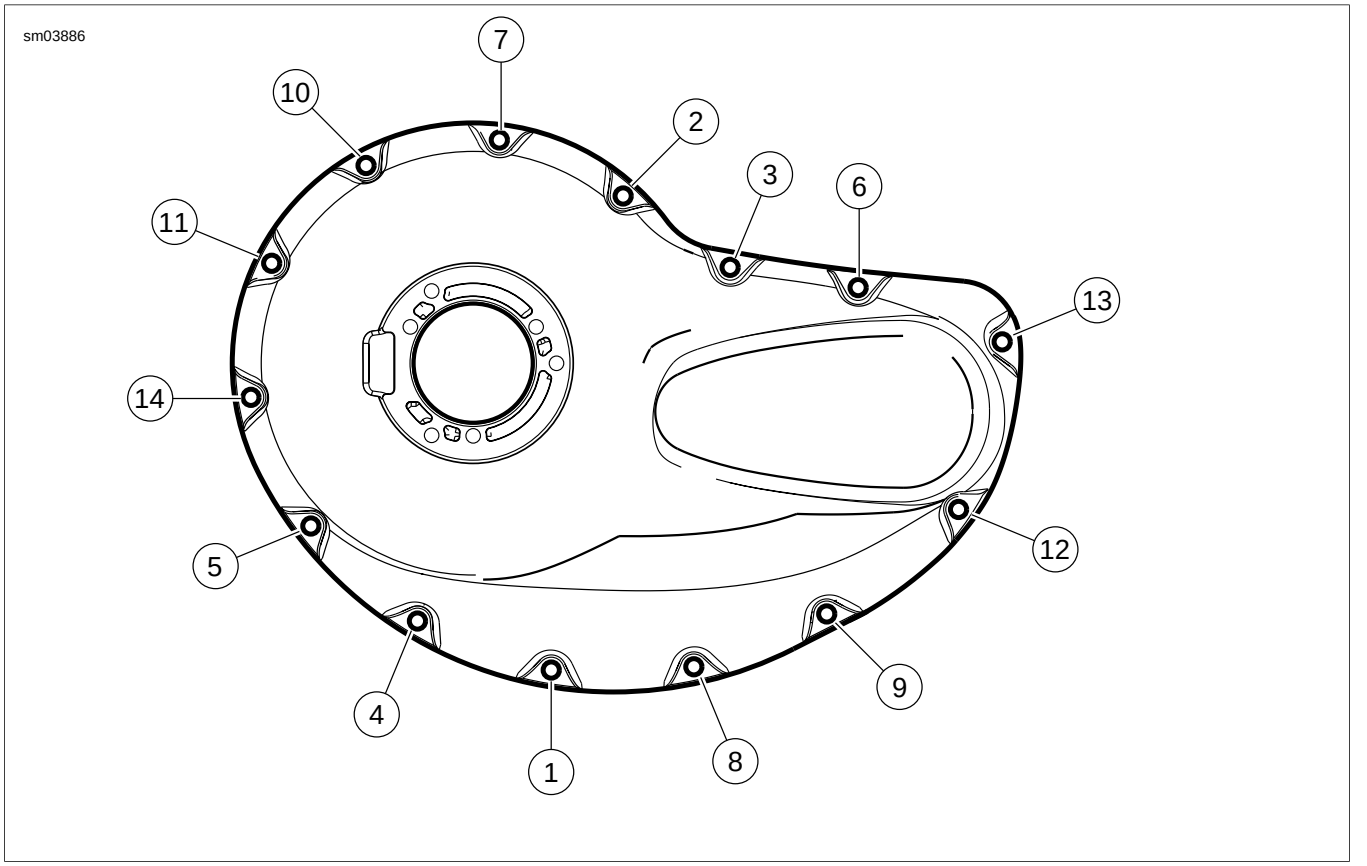
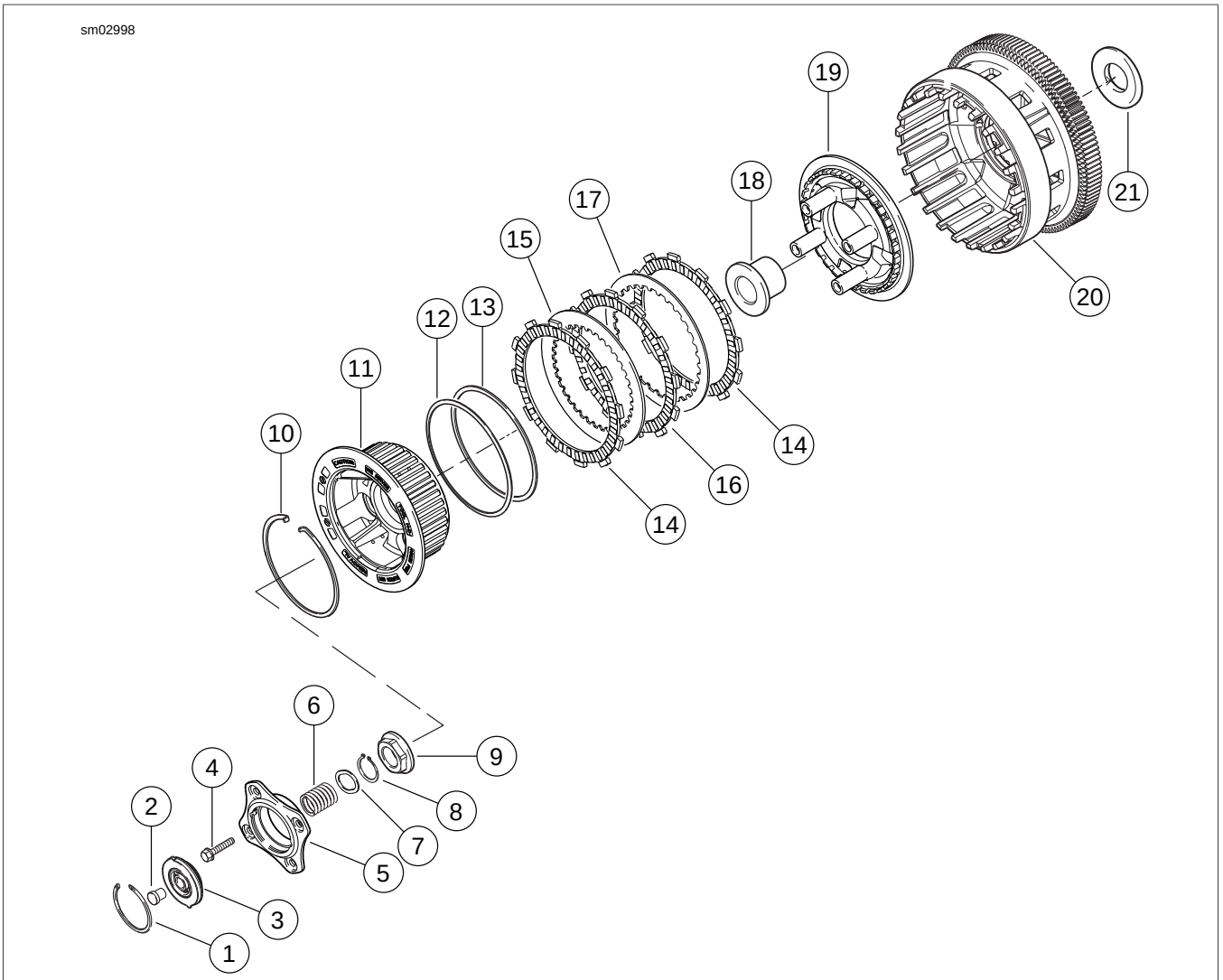



**Figure 7-2. Clutch Side Crankcase Cover Torque Sequence @ 9.7 Nm (86 in-lbs)**




1. **Retaining ring**
2. **Contact button**
3. **Lifter guide**
4. **Bolt (4)**
5. **Lifter plate**
6. **Pressure plate spring (4)**
7. **Pressure plate spring seat (4)**
8. **Clutch hub nut retaining ring**
9. **Clutch hub nut**
10. **Oil retaining ring**
11. **Clutch hub**
12. **Damper spring seat**
13. **Damper spring**
14. **Friction plate (with close-spaced friction material) (2)**
15. **Separator plate (small I.D.) (7)**
16. **Friction plate (with wide spaced fiction material) (7)**
17. **Separator plate (large I.D.) (1)**
18. **Distance collar**
19. **Pressure plate**
20. **Clutch basket**
21. **Thrust washer**

**Figure 7-3. Clutch**

**WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

5. See Figure 7-4. Remove retaining ring and lifter guide.

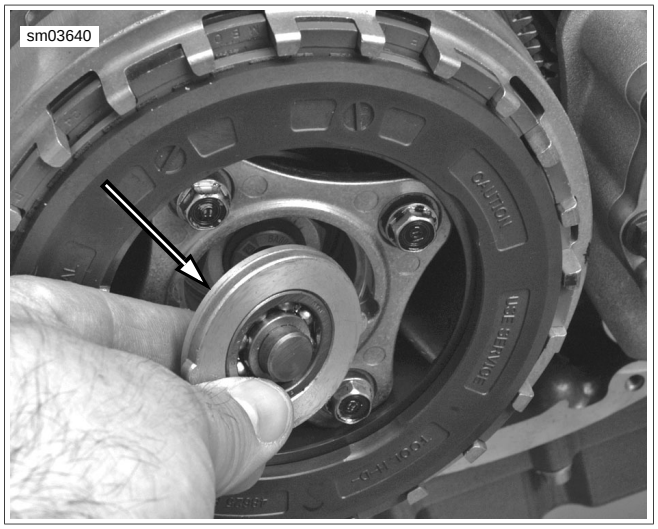



**Figure 7-4. Lifter Guide**

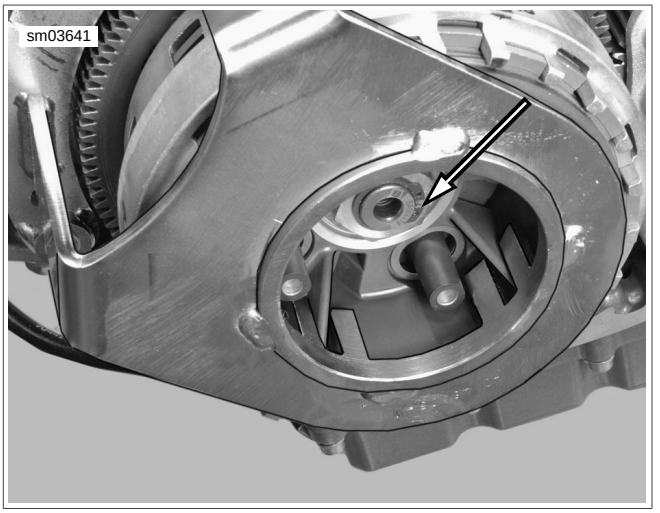



**Figure 7-5. Clutch Hub Nut Retaining Ring**

6. See Figure 7-5. Remove clutch hub nut retaining ring.
7. See Figure 7-3 and Figure 7-6. Remove oil retaining clip (5) for proper tool installation.
8. See Figure 7-7. Install CLUTCH HUB HOLDER (Part No. HD-48625). The clutch hub holder can only be installed in one position. The engine case dowel pin must match the hole in the tool.

*NOTE*

*Use CRANKSHAFT ROTATING WRENCH (Part No. HD-45314) to rotate engine.*

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

9. See Figure 7-8. Be sure to properly engage the clutch hub.

*NOTES*

- *It may be necessary to rotate engine slightly to properly engage the clutch hub.*
- *When LOCTITE® cannot be broken under normal conditions with conventional methods, apply moderate heat or use an air impact wrench ONLY TO LOOSEN clutch hub mainshaft nut. Failure to do so may result in damaged clutch hub and/or threads.*




**Figure 7-6. Oil Retaining Clip**

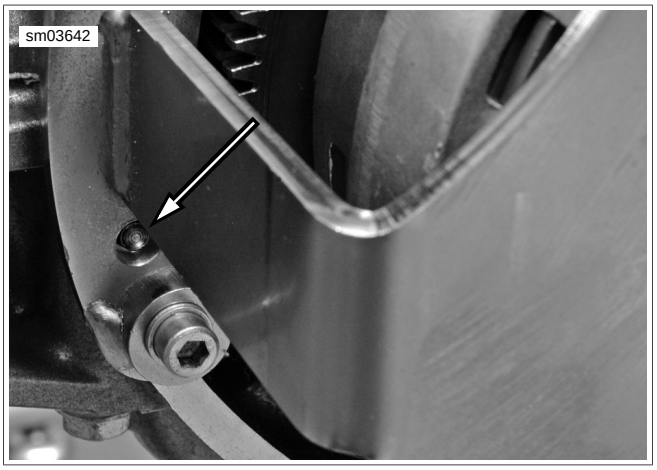



**Figure 7-7. Clutch Hub Holder Dowel Pin Position**

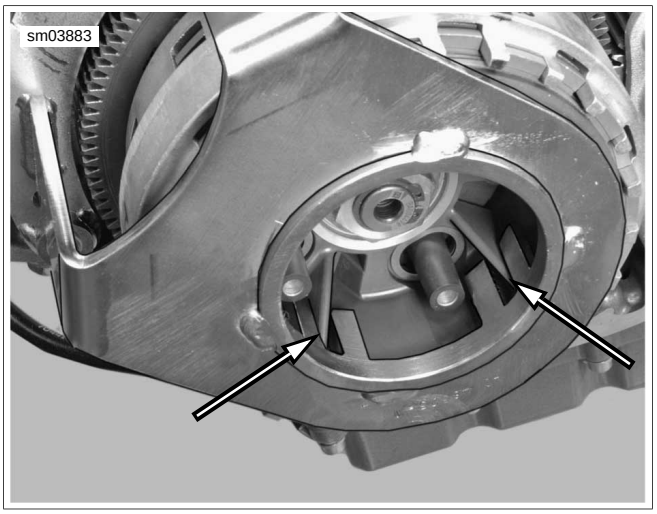



**Figure 7-8. Tool and Hub Properly Engaged**

**WARNING**

**Be sure to follow manufacturer's instructions when using propane torches. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00465c)**

*NOTE*

*When applying heat to the clutch hub mainshaft nut, do so carefully. Excessive heat will damage pressure plate springs.*

10. Heat clutch hub nut with a propane torch to loosen LOCTITE®. If necessary, an air impact can be used (REMOVAL ONLY) to remove nut.
11. See Figure 7-9. Remove clutch hub nut.

*NOTE*

*CLUTCH HUB NUT (Part No. HD-8008M) is one-time-use only. Always use a new nut for assembly.*

12. Remove CLUTCH HUB HOLDER (Part No. HD-48625).
13. See Figure 7-10. Remove clutch assembly.
14. See Figure 7-11. Note position of thrust washer behind the clutch basket.

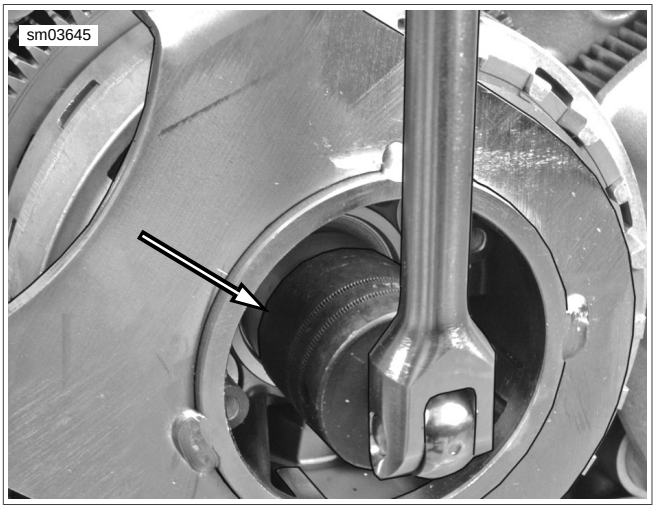



**Figure 7-9. Remove Clutch Hub Nut**

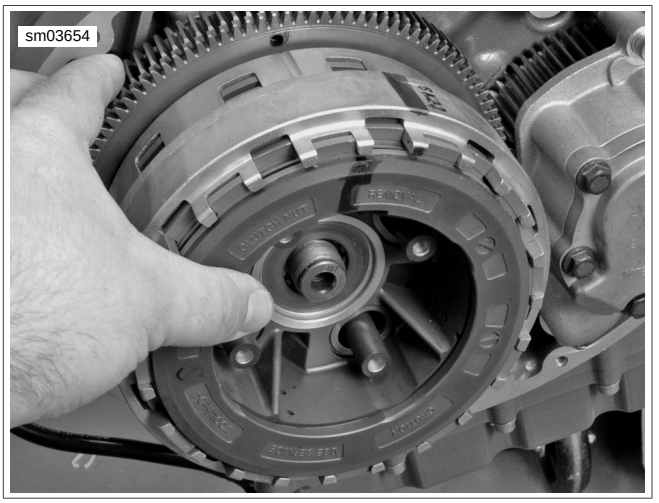



**Figure 7-10. Remove Clutch Assembly**

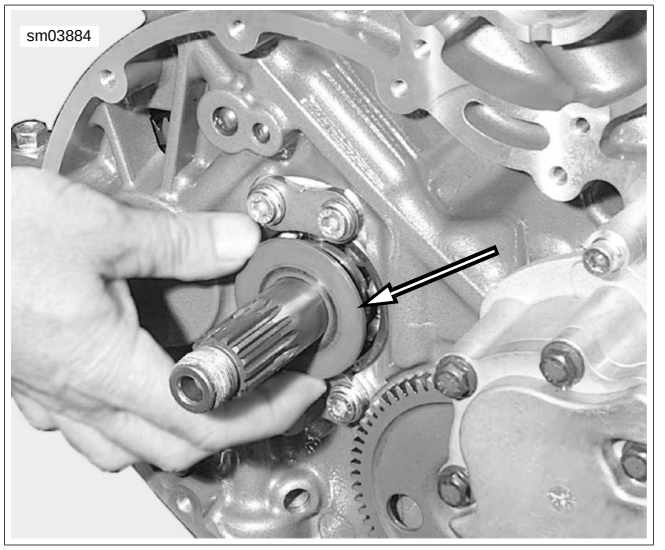



**Figure 7-11. Thrust Washer Position**

## DISASSEMBLY

1. See Figure 7-12. Remove clutch pack from clutch basket.
2. See Figure 7-13. To prevent breaking lifter plate, slowly loosen (2-3 turns at a time) fasteners in a crisscross pattern.
3. See Figure 7-14. Remove clutch springs and measure clutch spring free length.
4. Replace clutch springs if free length is less than 42 mm (1.65 in).
5. Slide hub from the clutch plate. Remove friction plates and steel plates for inspection.

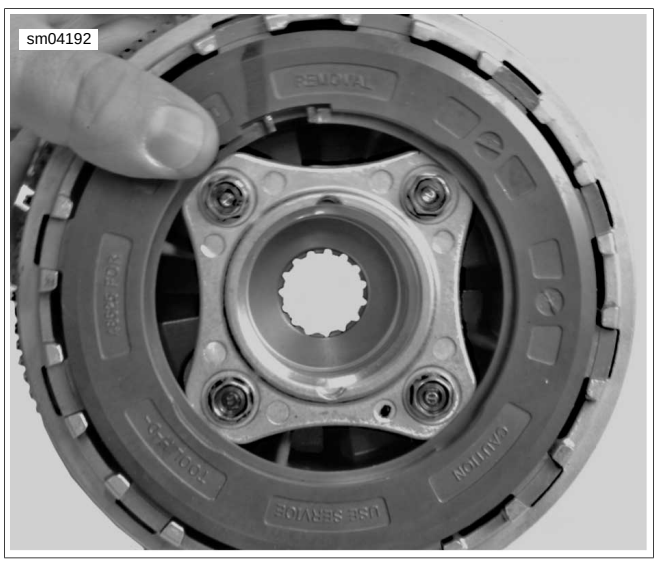



**Figure 7-12. Remove Clutch Pack From Clutch Basket**




**Figure 7-13. Lifter Plate Fasteners**

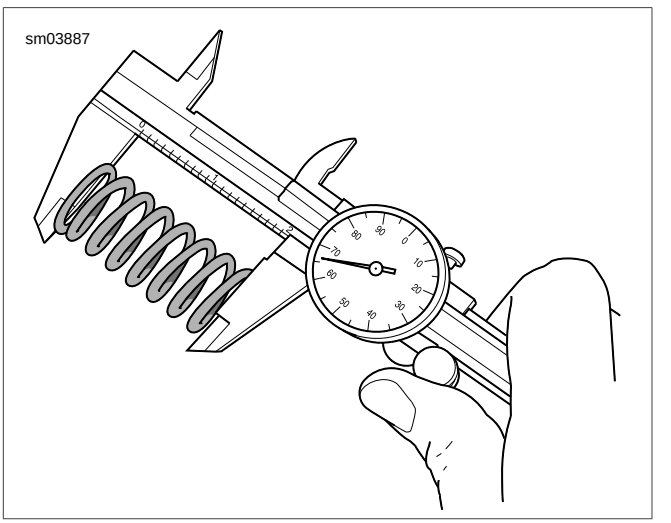



**Figure 7-14. Measure Clutch Spring Free Length**

## CLEANING AND INSPECTION

**⚠WARNING**

**Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)**

1. Wash all parts in cleaning solvent, except for friction plates and bearing, if removed. Blow parts dry with low pressure compressed air.

2. Check friction plates as follows:
   a. Blow off all lubricant from the **friction plates**. Do not wipe off with a rag.
   b. Look for worn or damaged fiber surface material (both sides)
   c. Measure the thickness of each plate with a dial caliper or micrometer.
   d. If the thickness of any plate is less than 3.62 mm (0.142 in.), discard all friction plates and replace with an entirely **new** set.

*NOTE*

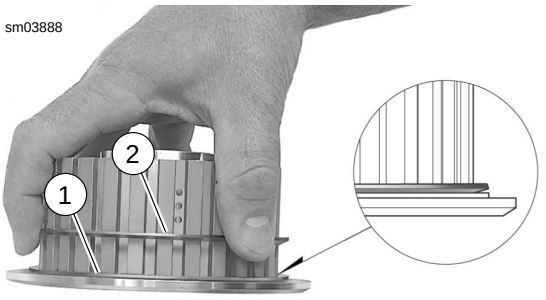
*Replace all nine friction plates with an entirely new set if any individual plate shows evidence of wear or damage. Friction plates must be presoaked before installation.*

3. Check the **steel plates** as follows:
   a. Discard any plate that is grooved or bluish in color. Blue plates are likely warped or distorted.
   b. Check each plate for distortion. Lay the plate on a precision flat surface. Insert a feeler gauge between the plate and the flat surface in several places. Replace any steel plate that is warped more than 0.15 mm (0.006 in.).
4. Holding the clutch hub, rotate the pressure plate to check bearing for smoothness. Replace the bearing if it runs rough, binds or has any end play.
5. Check ramps for excessive wear. Replace hub if ramps are worn or damaged.

## ASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45654 | CLUTCH DISC ALIGNING SPACER |

1. See Figure 7-15. Slide steel damper spring with concave side up into position on spring seat on clutch outer hub.




**1. Damper spring seat**
**2. Damper spring**

**Figure 7-15. Damper Spring Position**

*NOTES*

- *New plates should be soaked for 10 minutes in Harley-Davidson Motorcycle Oil 20W50 and assembled wet.*
- *Note different spacings in friction material on friction plates, as well as one larger inner-diameter steel plate. The closely spaced friction material plates go ONLY on the outboard positions during assembly.*

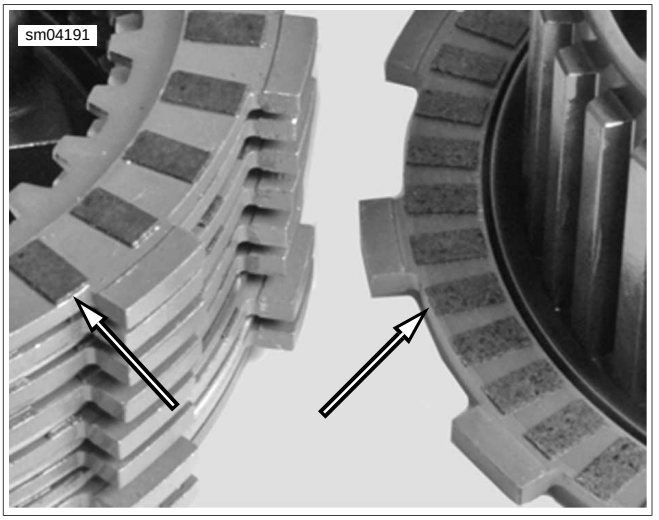



**Figure 7-16. Friction Plate Material Spacing Difference (outboard plate shown on right)**

2. See Figure 7-16. Install one closely-spaced friction material plate onto clutch hub, and one onto pressure plate.

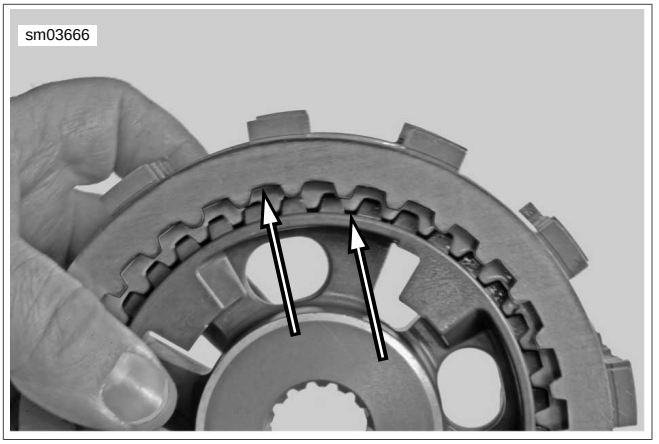



**Figure 7-17. Difference in Steel Plate Diameters**

3. See Figure 7-17. Note inside diameter difference on single steel plate.

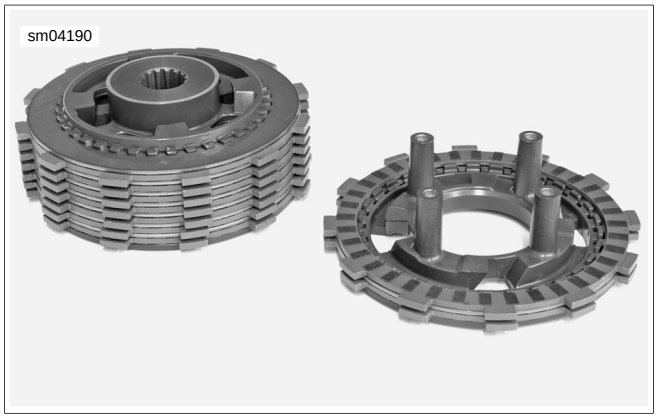



**Figure 7-18. Proper Stacking of Spacer and Friction Plates**

4. See Figure 7-18. Install large inside diameter steel plate on top friction plate previously installed on pressure plate, then a regular-spaced friction plate as shown.
5. Stack remaining plates on clutch hub; alternating friction plate, steel plate until all plates are in place.




**Figure 7-19. Assemble Clutch Hub and Pressure Plate**

6. See Figure 7-19 Place assembled clutch hub on bench, and assembled pressure plate in hand, slowly mate clutch halves until fully seated and align plate tabs so clutch pack assembly can drop into clutch basket under it's own weight.

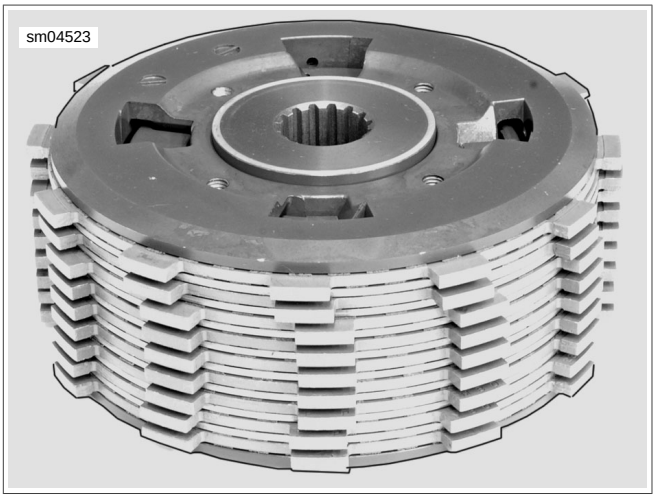



**Figure 7-20. Clutch Pack Assembled Correctly**

7. See Figure 7-20. Verify clutch pack is fully seated as shown with no space visible between plates and carefully flip clutch pack over onto the opposite side.

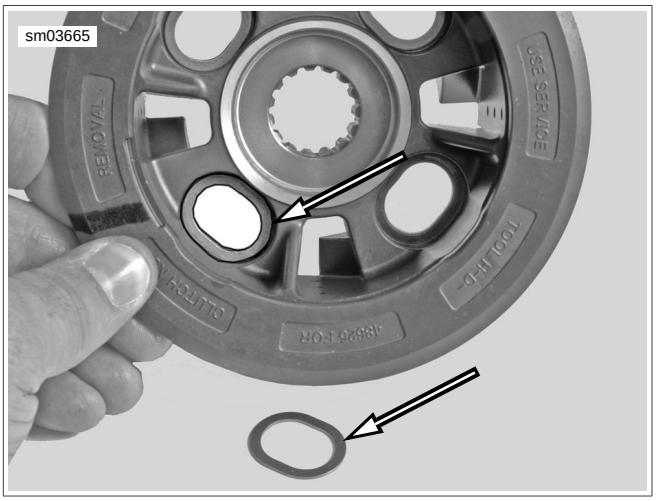



**Figure 7-21. Spring Seat Washer and Location on Clutch Hub**

8. See Figure 7-21. Place a small amount of oil on each spring seat washer and install four pressure plate spring seat washers.

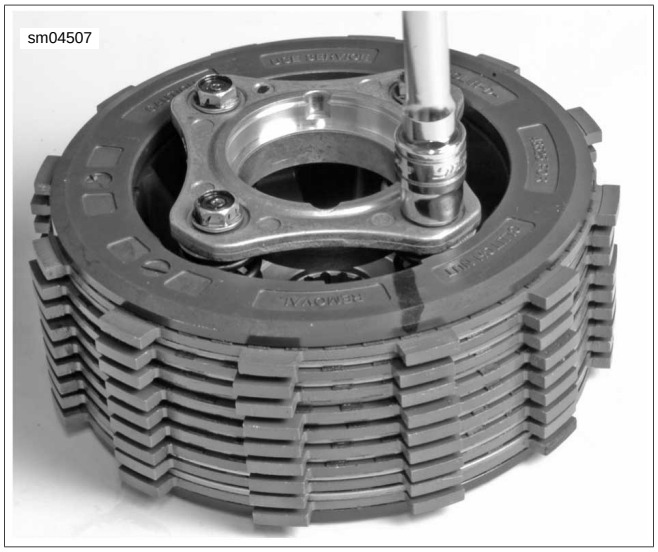



**Figure 7-22. Assemble Clutch Pack**

9. See Figure 7-22. Install four pressure plate springs over the threaded bosses on the pressure plate. Position the lifter plate over the springs and loosely install fasteners to allow clutch plates to be moved for final alignment.

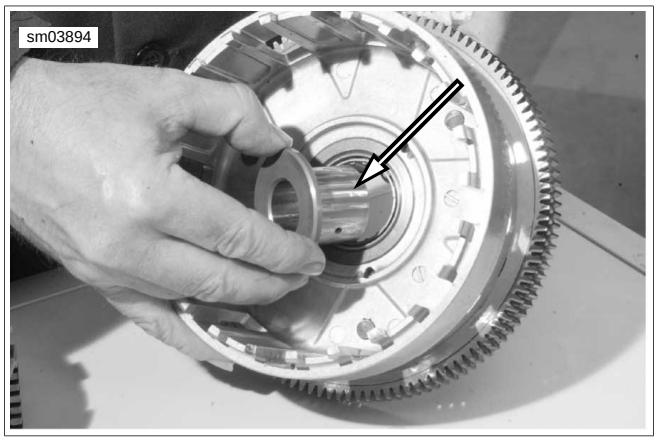



**Figure 7-23. Distance Collar**

10. See Figure 7-23. Install distance collar in clutch basket as shown.

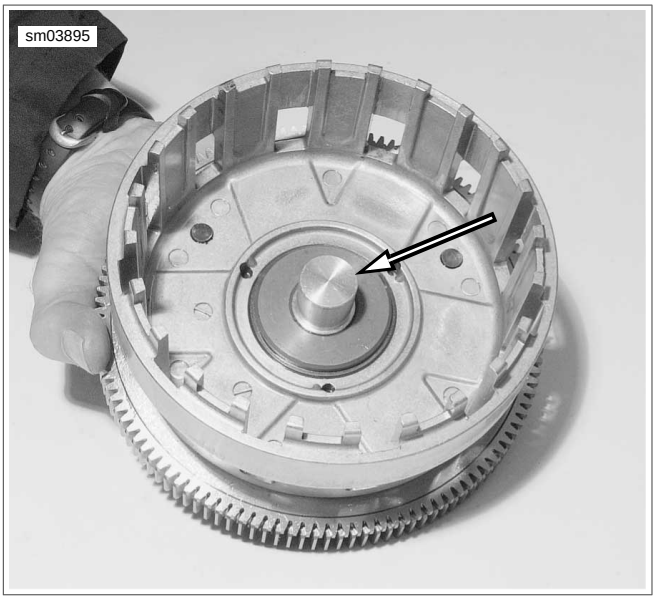



**Figure 7-24. Clutch Disc Aligning Spacer (HD-45654)**

11. See Figure 7-24. Insert CLUTCH DISC ALIGNING SPACER (Part No. HD-45654) from the primary gear side.




**Figure 7-25. Insert Clutch Pack and Align Top Plate as Shown**

12. See Figure 7-25. Insert clutch pack and align top friction plate. Top friction plate must be indexed to fit in the top slot of the clutch basket.




**Figure 7-26. Spring Screws**

13. See Figure 7-26. Using a cross pattern, tighten four spring screws to 9.7 Nm (86 **in-lbs**).




**Figure 7-27. Oil Retaining Clip**

14. See Figure 7-27. Install oil retaining clip.

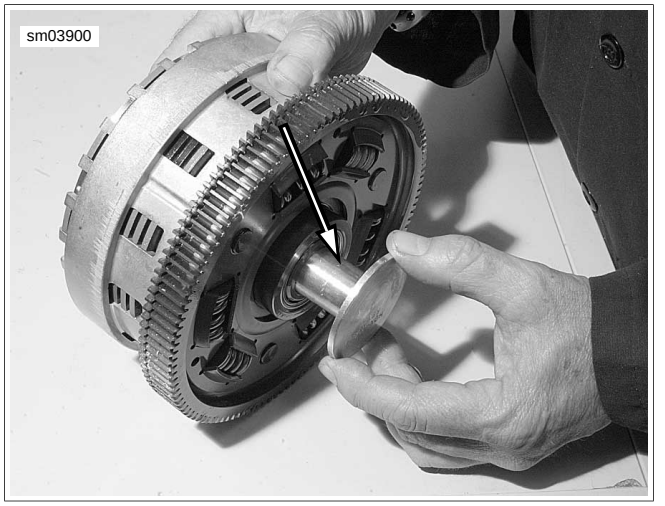


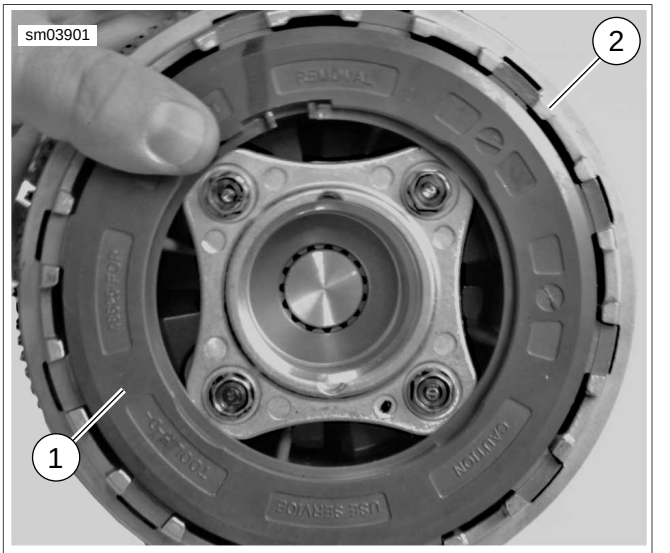

**Figure 7-28. Remove Clutch Disc Aligning Spacer Tool (HD-45654)**

15. See Figure 7-28. Remove CLUTCH DISC ALIGNING SPACER (Part No. HD-45654).

## INSTALLATION

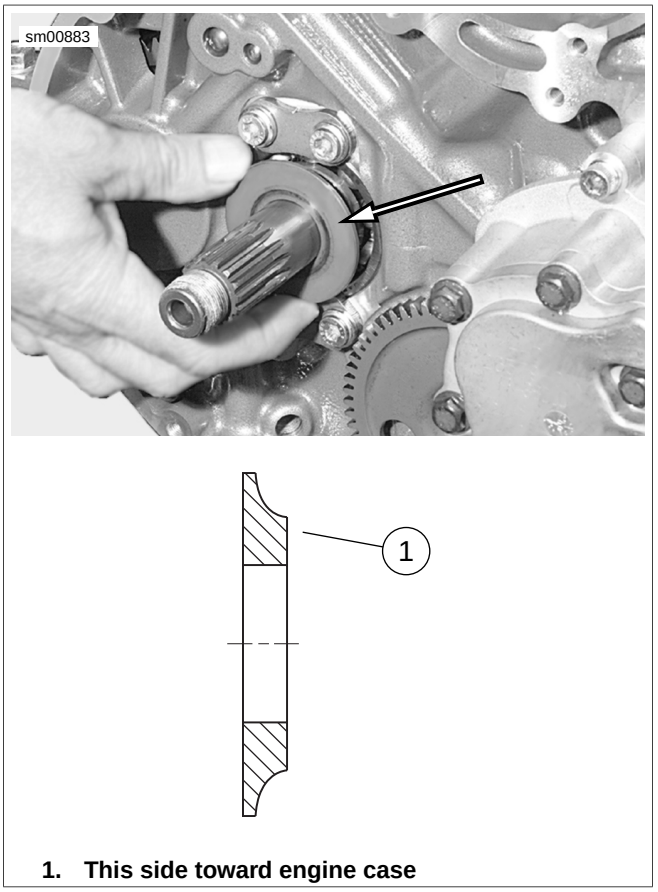
| PART NUMBER | TOOL NAME |
|---|---|
| HD-45340 | GASKET ALIGNMENT DOWELS |
| HD-48625 | CLUTCH HUB HOLDER |

1. See Figure 7-29. Remove clutch pack from clutch basket.
2. See Figure 7-30. Install thrust washer.
3. See Figure 7-31. Slide clutch basket on to the input shaft.




1. **Clutch Pack**
2. **Clutch Basket**

**Figure 7-29. Remove Clutch Pack From Clutch Basket**




1. **This side toward engine case**

**Figure 7-30. Thrust Washer Position**




**Figure 7-31. Clutch Basket**

4. See Figure 7-32. Clutch basket will not go completely into position until the spring loaded backlash gear is aligned. Use a suitable drift pin in hole to align backlash gear.
5. See Figure 7-33. Slide clutch pack into clutch housing. It may be necessary to rotate input shaft to align splines of shaft and outer hub.
6. See Figure 7-7. Install CLUTCH HUB HOLDER (Part No. HD-48625). The clutch hub holder can only be installed in one position. The engine case dowel pin must match the hole in the tool.

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**

7. See Figure 7-8. If necessary, rotate engine slightly to properly engage the clutch hub.

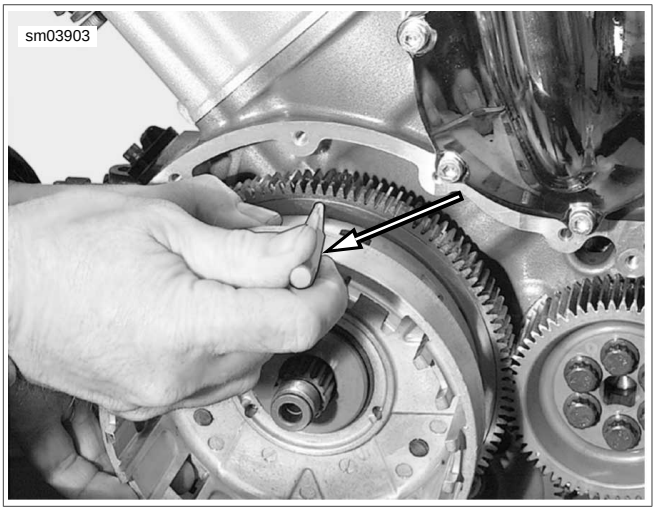



**Figure 7-32. Back Lash Gear Adjustment**

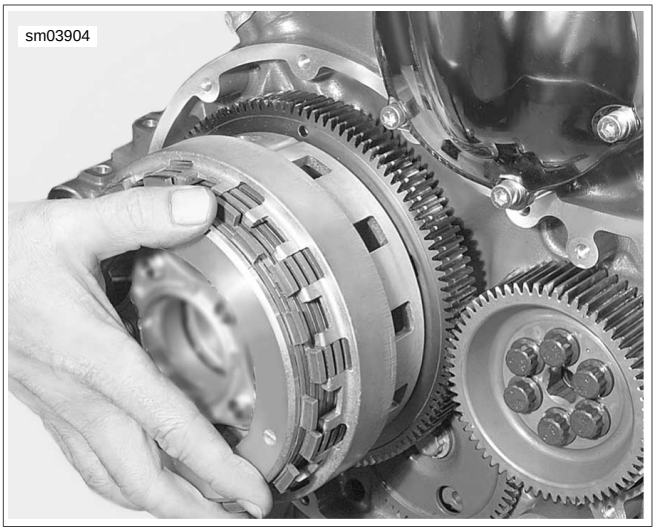



**Figure 7-33. Install Clutch Pack (typical)**

*NOTE*

*Clutch hub nut is one-time-use only. Always use a **new** nut for assembly.*

8. Install CLUTCH HUB HOLDER (Part No. HD-48625).
9. Install a **new** clutch hub nut and tighten to 220 Nm (162 ft-lbs).

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

10. Install **new** clutch hub nut retaining ring.
11. Remove CLUTCH HUB HOLDER (Part No. HD-48625).
12. Install oil retaining ring.
13. Install lifter guide and retaining ring.

*NOTE*

*Install GASKET ALIGNMENT DOWELS (Part No. HD-45340) to aid in cover installation.*

14. See Figure 7-34. Install clutch side crankcase cover. Tighten fasteners in sequence to 9.7 Nm (86 **in-lbs**).
15. Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (88 **in-lbs**).
16. Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-88 **in-lbs**).

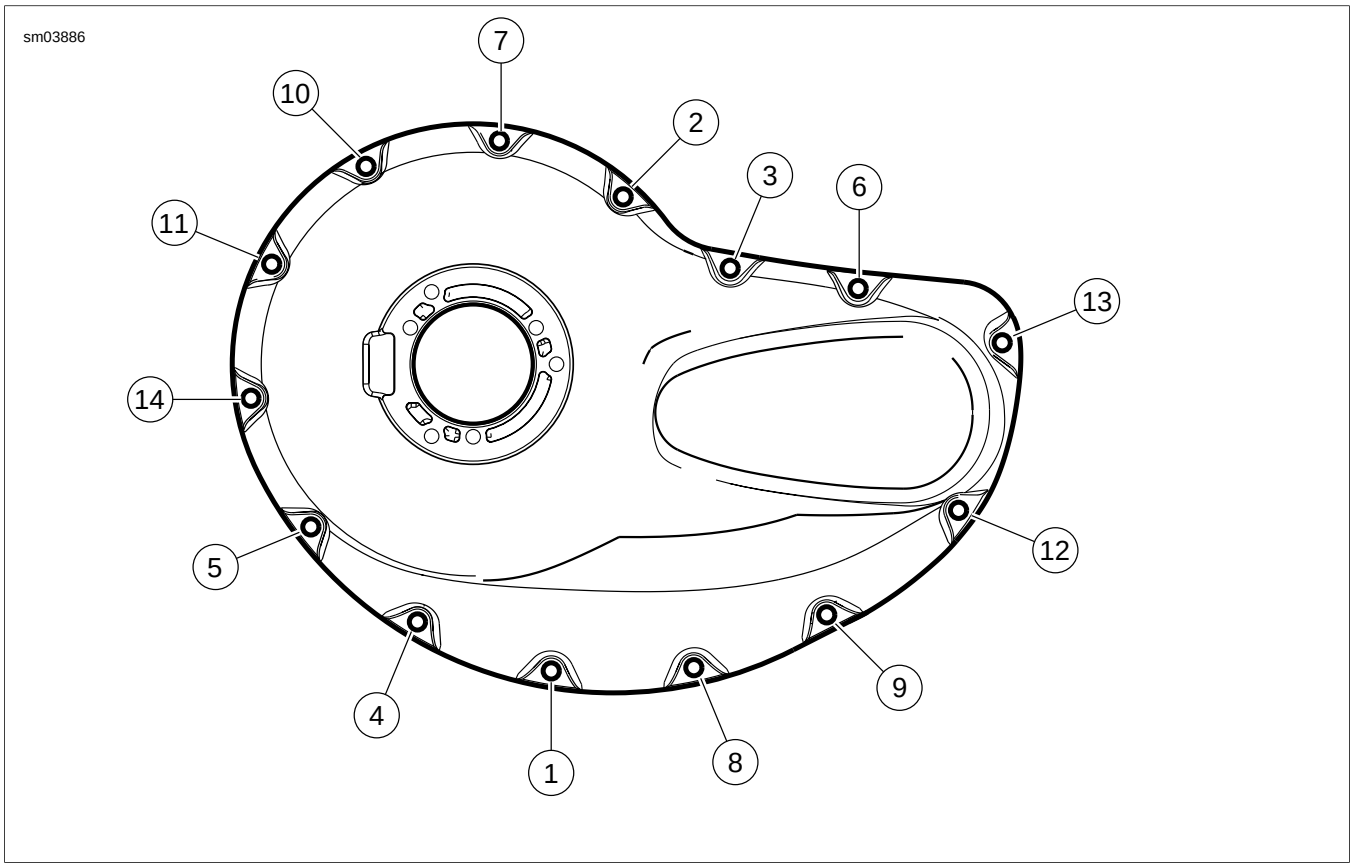



**Figure 7-34. Clutch Side Crankcase Cover Torque Sequence @ 9.7 Nm (86 in-lbs)**

## DISASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45339 | SHIFT MECHANISM/DENTENT RETRACTOR |

**CAUTION**

**Whenever case halves are separated for service, crankshaft bearings must be replaced. Failure to replace bearings will result in engine damage. (00551b)**

1. See Figure 7-35. Remove input shaft. See Figure 7-37. Note the alignment pins on the bearing outer race. If the pins are damaged or missing the bearing must be replaced.

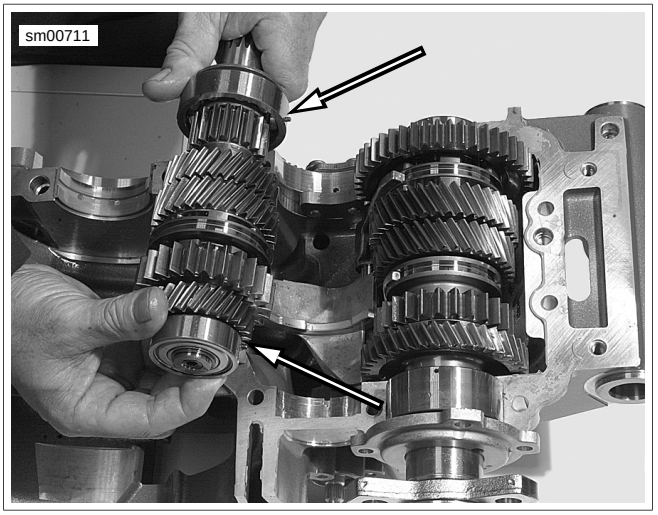



**Figure 7-35. Input Shaft**

2. Remove two fasteners on drive sprocket flange seal retainer.
3. See Figure 7-36. Remove output shaft.
4. See Figure 7-35. Note the alignment pins on the bearing outer race. If the pins are damaged or missing the bearing must be replaced. See 7.6 OUTPUT SHAFT.

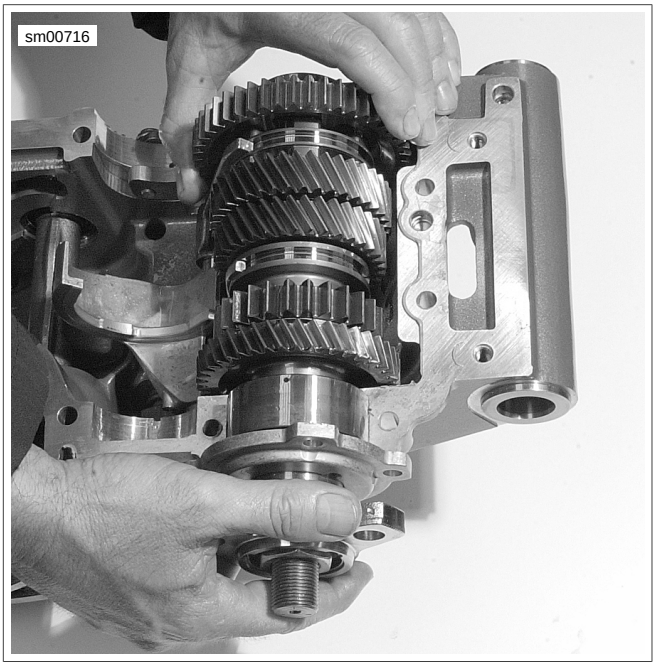
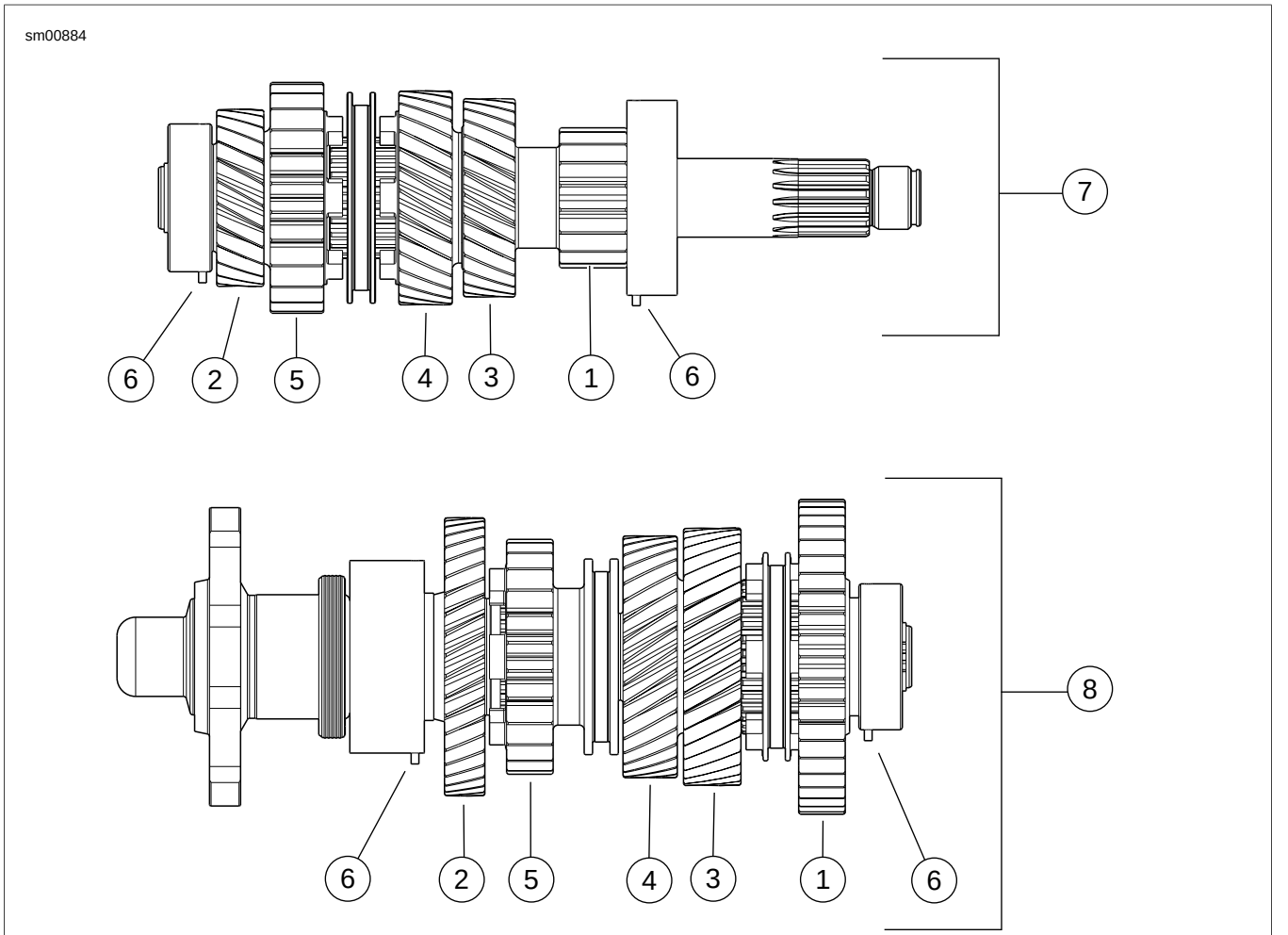



**Figure 7-36. Output Shaft**




1. **1st gear**
2. **2nd gear**
3. **3rd gear**
4. **4th gear**
5. **5th gear**
6. **Bearing alignment pins**

**Figure 7-37. Transmission Input Shaft and Output Shaft Assemblies**

## Shift Drum Removal

1. See Figure 7-38. Remove input shaft bearing retainer to fully expose shifting fork shaft.
2. See Figure 7-39. Remove neutral switch.
3. See Figure 7-40. Using a drift pin, pull shifter fork shaft to edge of case to free shifter forks.

*NOTE*

*Shafts in the transmission are closely toleranced. Insertion of shafts must be done by hand. NEVER use a hammer or other tool to remove or install shafts. Transmission damage will result if force is used to insert shafts.*

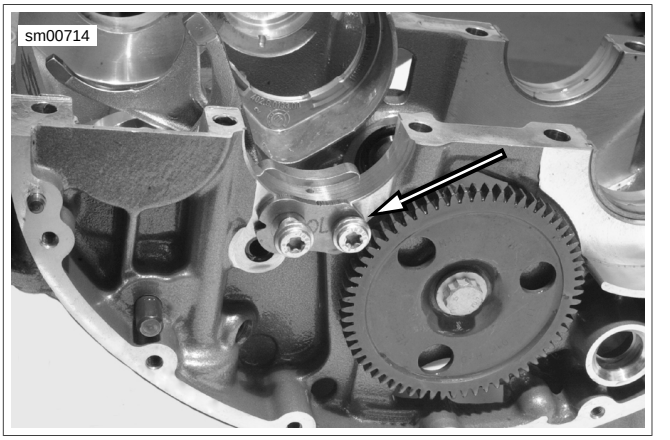



**Figure 7-38. Input Shaft Bearing Retainer**

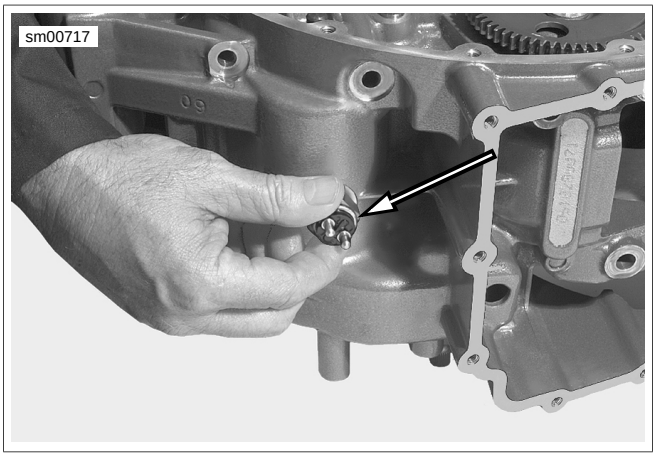



**Figure 7-39. Neutral Switch**

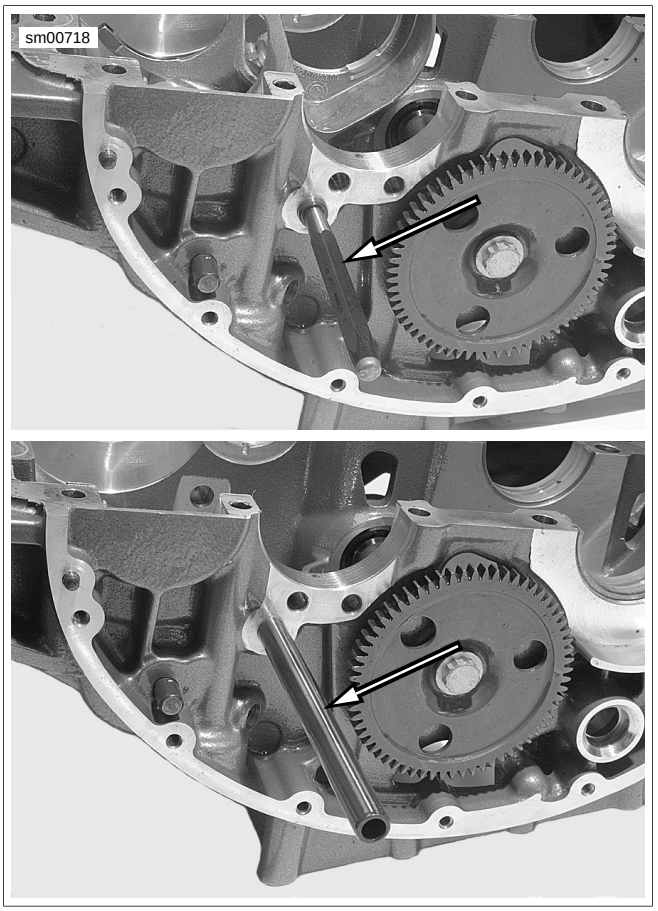



**Figure 7-40. Shifter Fork Shaft**

4. See Figure 7-41. Use the shifter fork shaft to position the SHIFT MECHANISM/DENTENT RETRACTOR (Part No. HD-45339).
   a. Engage the shifter gliding part, tighten brass thumb screw to keep gliding part in retracted position.
   b. Push shifter detent arm spring away from shifting drum star wheel. Lock in place with black knurled thumb screw.
   c. Extract shift drum shaft and remove shift drum.

*NOTES*

- *Always compress shifter pawl gliding part before shift drum detent arm moved out of position. Failure to do so could bend or break shift detent arm assembly tab.*
- *If the SHIFT MECHANISM/DENTENT RETRACTOR (Part No. HD-45339) is positioned correctly the shift drum will rotate freely.*
- *For shift shaft, or shift shaft seal removal, see 7.5 SHIFT SHAFT AND SEAL.*

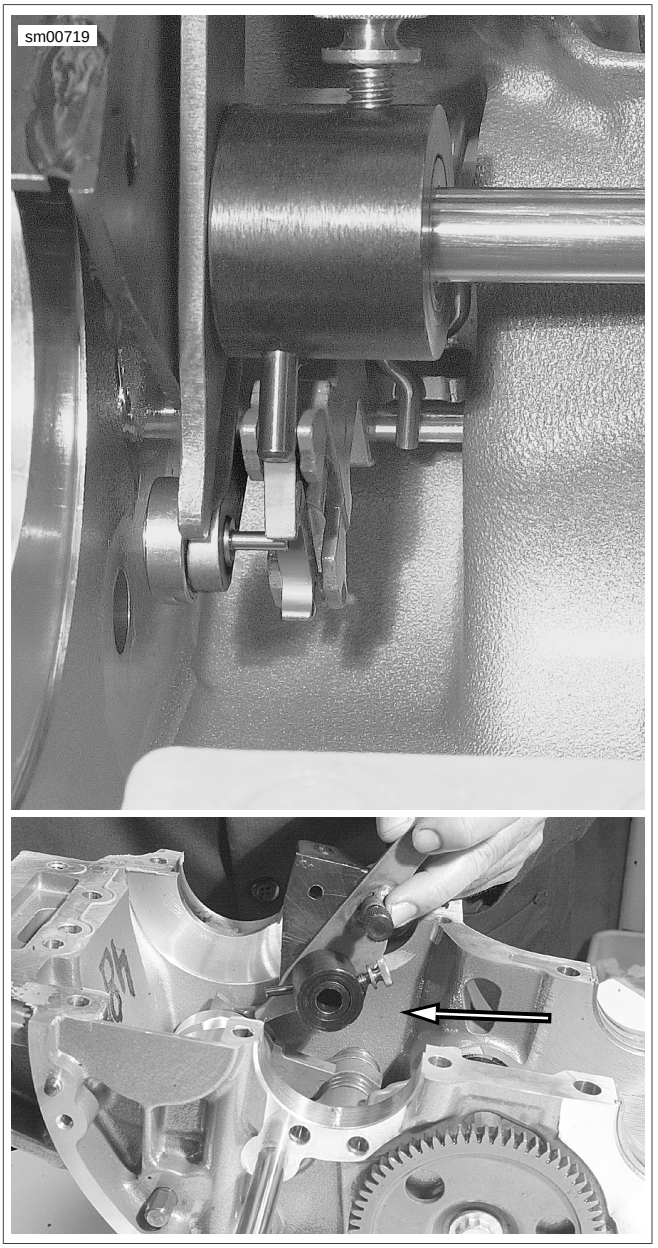



**Figure 7-41. Shift Mechanism/Detent Retractor (HD-45339)**

## ASSEMBLY

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45301 | TRANSMISSION ASSEMBLY RETAINER TOOL |
| HD-45301 | TRANSMISSION ASSEMBLY RETAINER |
| HD-45306 | CRANKSHAFT LOCKING PIN |
| HD-45310 | LOWER CRANKCASE ALIGNMENT DOWELS |
| HD-45311 | COUNTERBALANCER ALIGNMENT PIN |
| HD-45311 | COUNTERBALANCER ALIGNMENT PIN |
| HD-45316 | CRANKSHAFT ASSEMBLY RETAINER |
| HD-45338 | SHIFT LEVER SUBSTITUTE |
| SNAP-ON TA360 | TORQUE ANGLE GAUGE |

*NOTE*

*Shafts in the transmission are closely toleranced. Insertion of shafts must be done by hand. NEVER use a hammer or other tool to remove or install shafts. Transmission damage will result if force is used to insert shafts.*

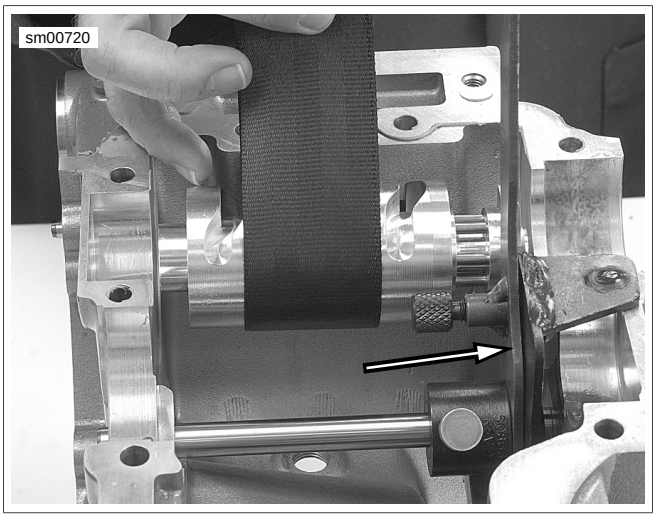



**Figure 7-42. Position Shift Drum**

1. See Figure 7-42. Use SHIFT MECHANISM/DENTENT RETRACTOR (Part No. HD-45339) in reverse of disassembly to compress shifter gliding part and to compress shifting detent arm and spring. Using the nylon strap from the SHIFT MECHANISM/DETENT RETRACTOR (Part No. HD-45339), lower the shift drum in place and insert the shift drum shaft.
2. See Figure 7-43. Insert shifter fork shaft through engine case and slide shifter forks in position.
3. See Figure 7-44. Shifter forks must be positioned as shown.
4. See Figure 7-45. Install input shaft bearing retainer loosely in place.

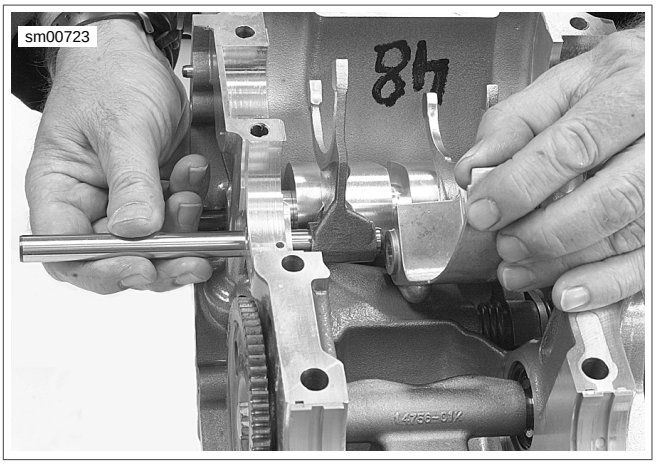



**Figure 7-43. Shifter Fork Shaft Installation**

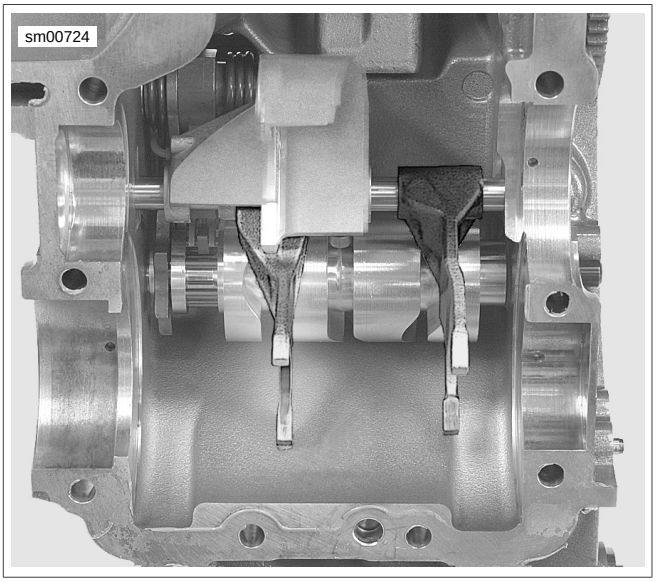



**Figure 7-44. Shifter Fork Orientation**

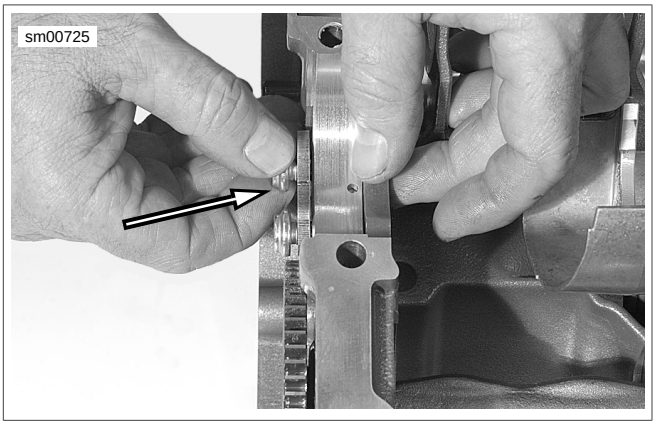



**Figure 7-45. Input Shaft Bearing Retainer**

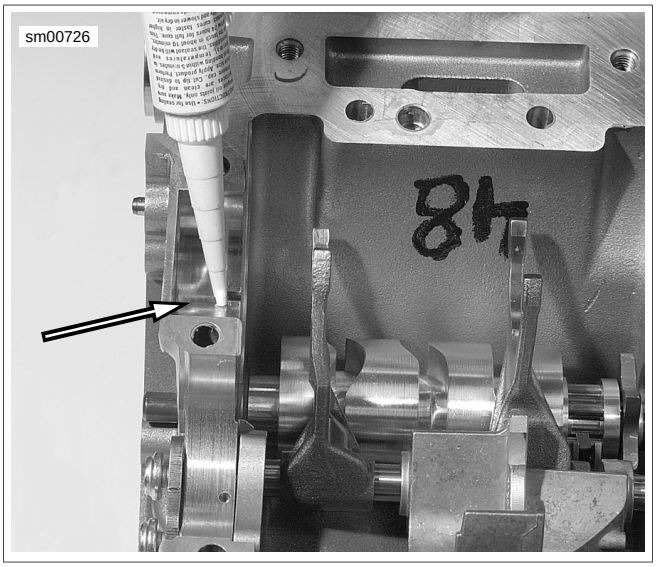



**Figure 7-46. Locating Pin Hole**

5. See Figure 7-46. A SMALL dab of HARLEY-DAVIDSON HIGH-PERFORMANCE SEALANT around the output bearing locating pin hole will help to keep bearing from dropping during assembly. This is ONLY DONE ON THE OUTPUT SHAFT FIRST GEAR BEARING.

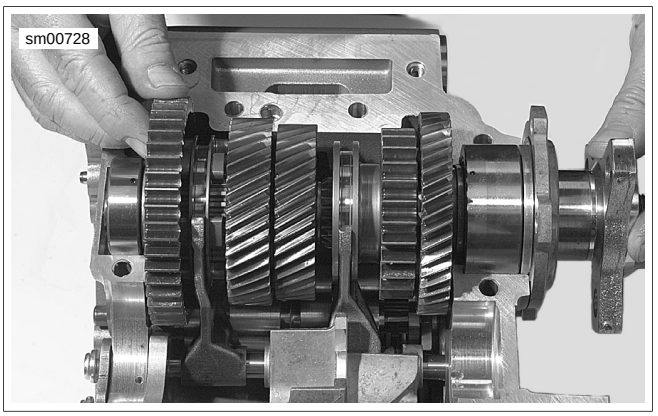



**Figure 7-47. Output Shaft**

*NOTE*

*Attempting to assemble engine without the bearing locating pins in the correct position, will cause engine damage.*

6. See Figure 7-47 and Figure 7-48. Carefully lower output shaft into case. Inspect to be certain that the alignment pins (6) on the bearing outer race are in the case holes.

*NOTE*

*Output shaft will turn freely when it is in the correct position.*

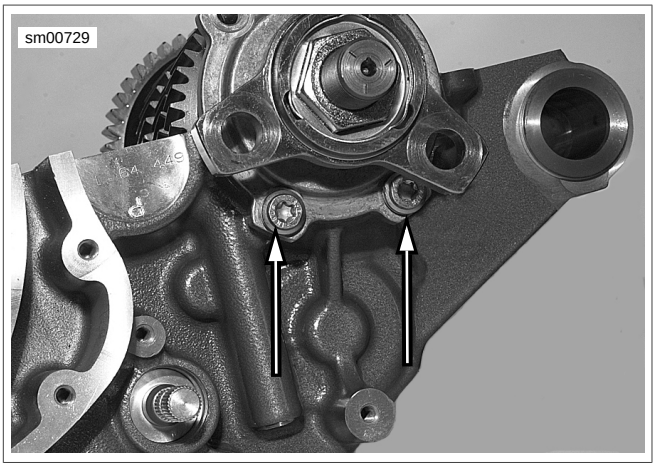



**Figure 7-48. Output Shaft Seal Retainer**

7. See Figure 7-48. Install two upper case fasteners in drive sprocket seal retainer. Do not tighten at this time.

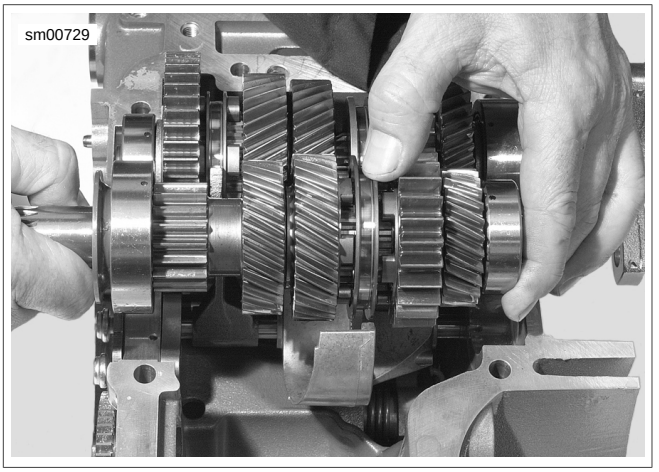



**Figure 7-49. Input Shaft**

*NOTE*

*Attempting to assemble engine without the bearing locating pins in the correct position, will cause engine damage.*

8. See Figure 7-49 and Figure 7-37. Carefully lower input shaft into case. Inspect to be certain that the alignment pins (6) on the bearing outer race are in the case holes and shifting forks are in the correct location.
9. See Install TRANSMISSION ASSEMBLY RETAINER TOOL (Part No. HD-45301) on input shaft.
10. Use SHIFT LEVER SUBSTITUTE (Part No. HD-45338) to dry shift transmission while rotating input and output shaft. Make sure transmission shifts through all gears correctly.
11. Install neutral switch. See 8.17 NEUTRAL SWITCH.

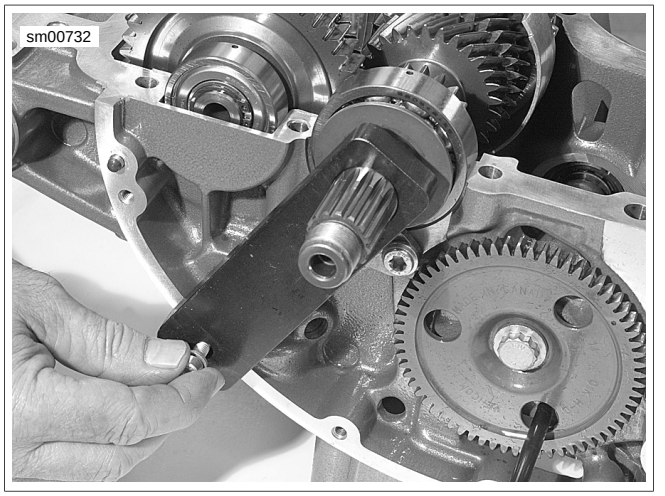



**Figure 7-50. Retain Input Shaft**

12. See Figure 7-50. Install TRANSMISSION ASSEMBLY RETAINER (Part No. HD-45301) on input shaft as shown.

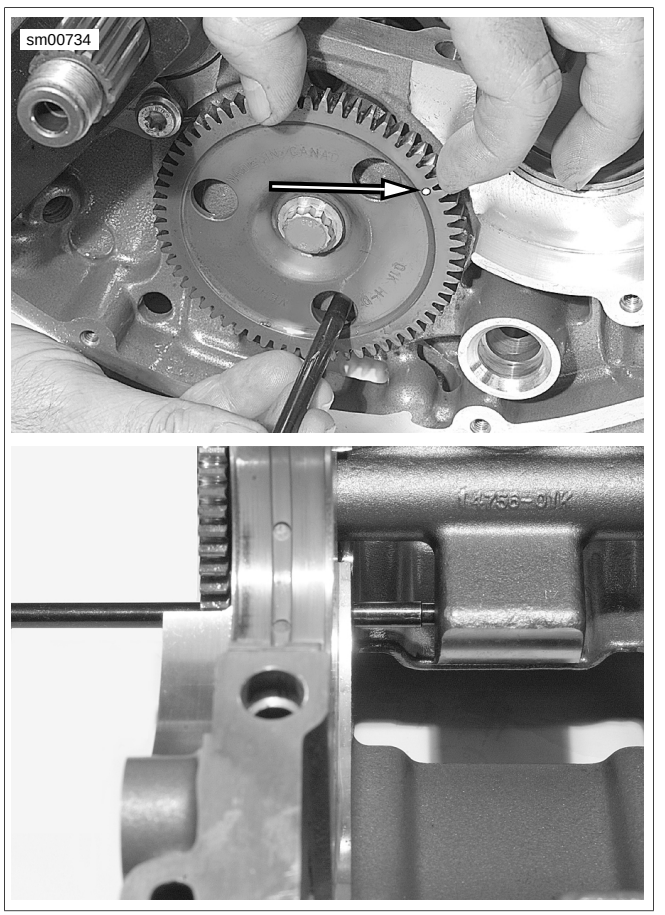



**Figure 7-51. Counterbalancer Alignment**

13. See Figure 7-51. Install COUNTERBALANCER ALIGNMENT PIN (Part No. HD-45311). With the alignment mark in the 2 o'clock position, the case hole and the index hole in the counterbalancer will align.

*NOTE*

*Crankshaft bearings must be replaced every time the cases are split for service. If the cam drive is not being serviced, crankshaft bearings can be replaced without removing the cam drive chain.*

14. Replace the crankshaft bearings at this time. See 3.11 ENGINE BOTTOM END SERVICE.

15. See Figure 7-52. Lubricate crankshaft bearing surfaces, input and output shaft and counterbalancer bearings with Harley-Davidson Motorcycle Oil 20W50. Use Lubriplate No. 105 Assembly Grease (NAPA Part No. 765-2651) on bearing shells.

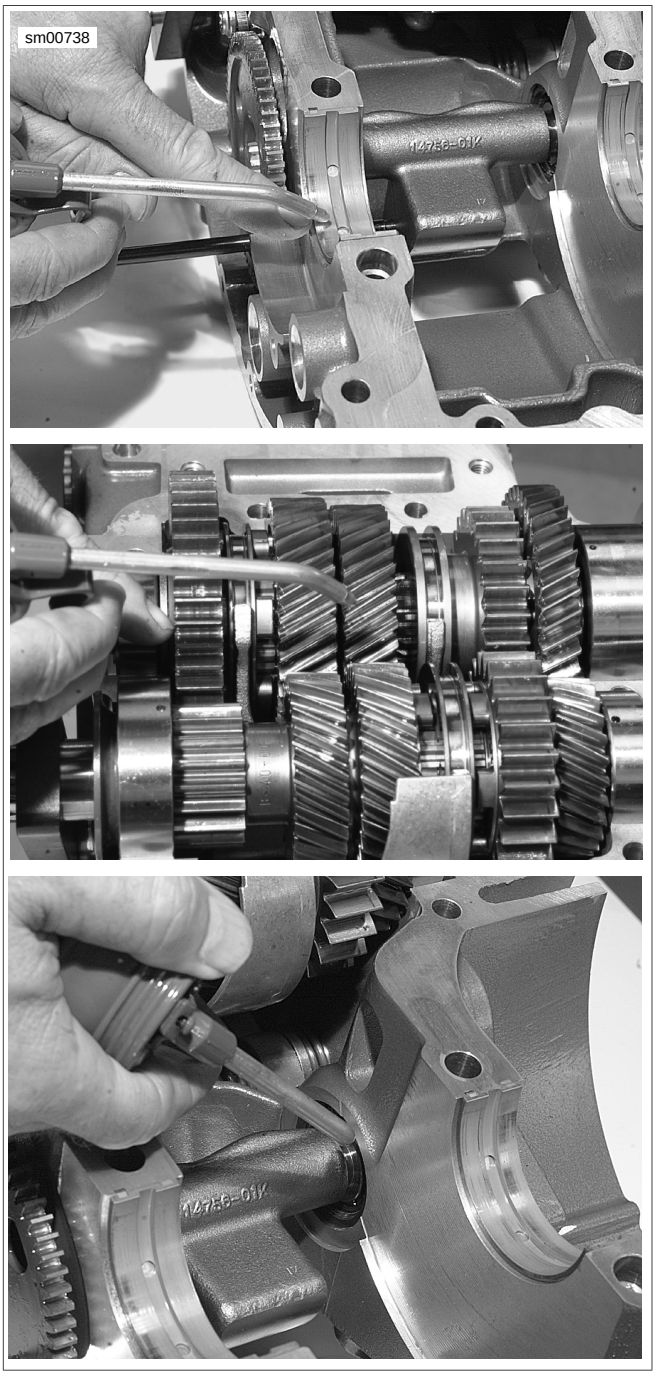



**Figure 7-52. Pre-Assembly Lubrication**

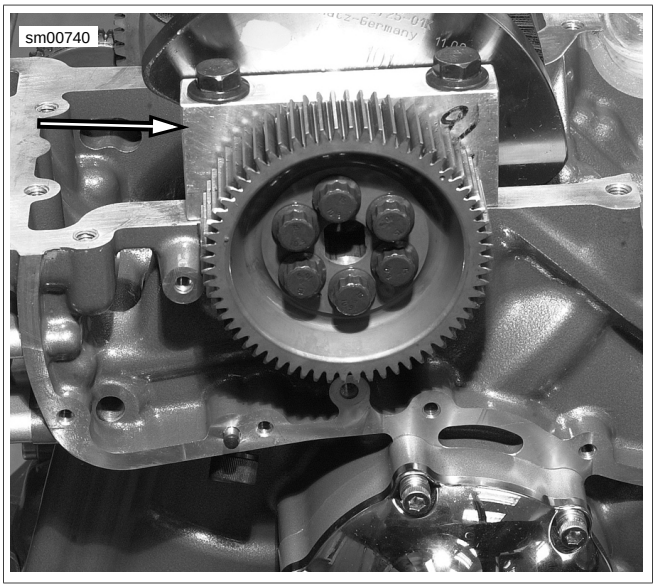



**Figure 7-53. Retain Crankshaft Thrust Bearing**

16. See Figure 7-53. If engine was not at TDC, position the CRANKSHAFT ASSEMBLY RETAINER (Part No. HD-45316) to hold crankshaft thrust bearing half in place while attaining TDC.

**CAUTION**

**Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)**




**Figure 7-54. Crankshaft Locking Pin (HD-45306)**

17. See Figure 7-54. Position the crankshaft assembly at TDC and insert the CRANKSHAFT LOCKING PIN (Part No. HD-45306).

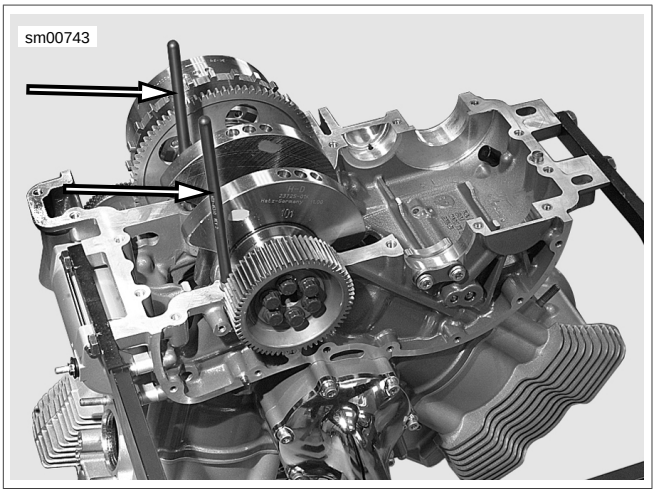



**Figure 7-55. Lower Crankcase Alignment Dowels (HD-45310)**

18. See Figure 7-55. Install LOWER CRANKCASE ALIGNMENT DOWELS (Part No. HD-45310).

*NOTE*

*If dipstick has not been removed, do so at this time.*

19. See Figure 7-45. Check that upper crankcase input bearing retainer is loosely in position.

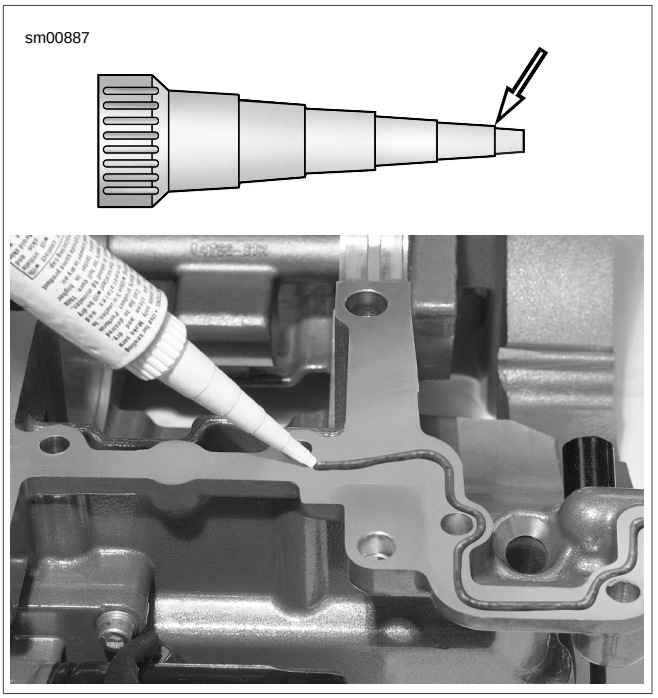



**Figure 7-56. Apply Sealant**

20. See Figure 7-56 and Figure 7-57. Cut HARLEY-DAVIDSON HIGH-PERFORMANCE SEALANT (Part No. 99650-02) applicator tip at first step.

*NOTES*

- *Carefully clean case mating surfaces (gray shaded area).*
- *Apply 1 mm (0.04 in.) VRSC Crankcase Sealant (HD-99650-02) following black line.*
- *Apply sealant only as indicated - DO NOT seal all mating surfaces.*

*NOTE*

*Excess VRSC Crankcase Sealant squeezed into the crankcases during assembly can clog the oil pick up.*

21. Adjust speed and pressure to apply a 1 mm (0.04 in.) bead of sealant to the lower case half.

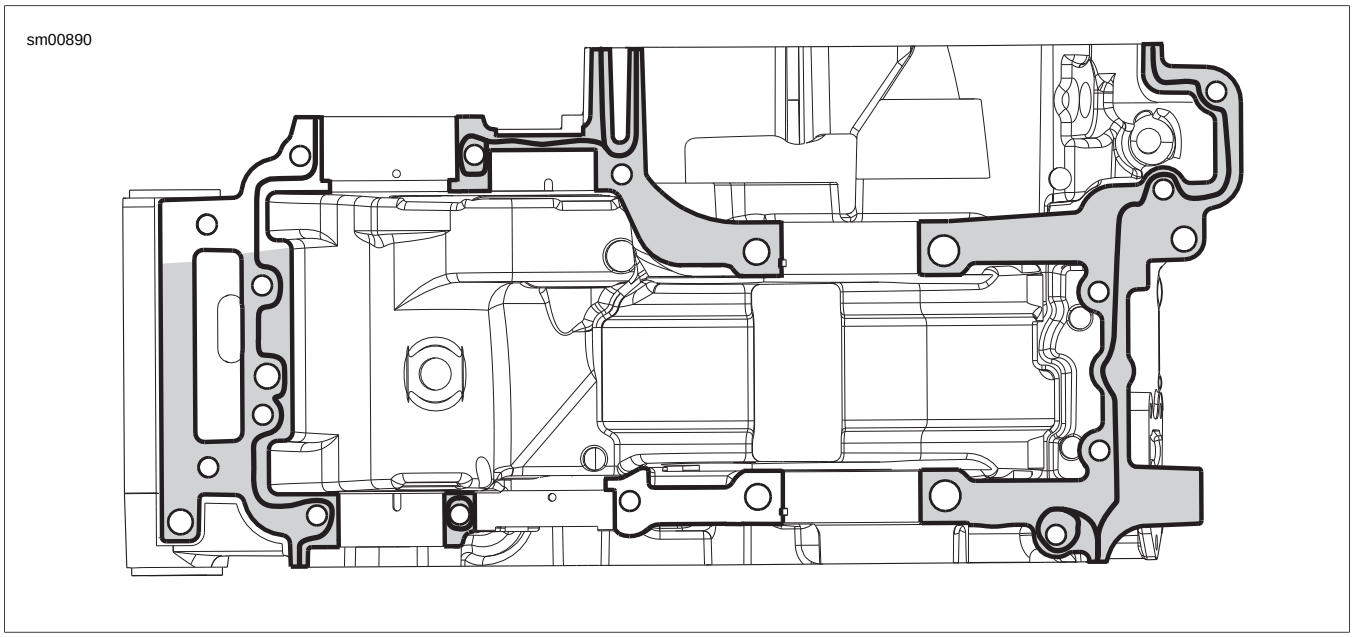
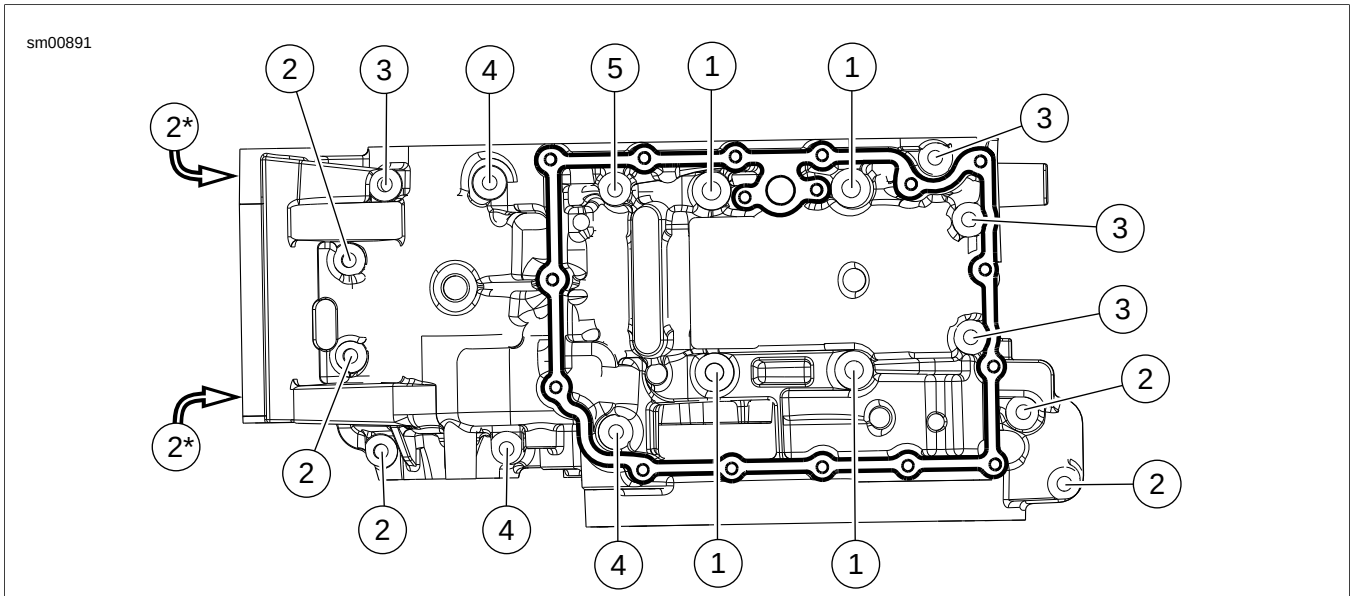



**Figure 7-57. Lower Case Sealant Path**




1. **M10x150 (Part No. 968M)**
2. **M8x40 (Part No. 970M)**
3. **M8x90 (Part No. 1025M)**
4. **M8x120 (Part No. 973M)**
5. **M8x160 (Part No. 972M)**

**Figure 7-58. Case Fastener Sizes (*Insert from upper case half)**

*NOTES*

- *Lower case with the transmission gears in place is heavy. Get assistance when lifting lower case.*
- *It is also possible when using rolling engine stand and engine cradle to mate cases vertically when engine is positioned with starter facing upward.*

22. See Figure 7-59. Position lower case half over the LOWER CRANKCASE ALIGNMENT DOWELS (Part No. HD-45310).
23. See Figure 7-60. When the counterbalancer gear and the primary crankshaft gear are close to engagement, remove the COUNTERBALANCER ALIGNMENT PIN (Part No. HD-45311).

*NOTE*

*Confirm the correct alignment of the counterbalancer gear and the primary crankshaft gear timing marks. Engine damage will occur if the counterbalancer gear and the primary crankshaft gear are not correctly timed.*

24. See Figure 7-61. Hand position the counterbalancer gear so the timing marks are aligned exactly as shown.
25. Verify that transmission input and output shafts spin freely.
26. See Figure 7-58. Match and thread-in all 19 case fasteners.

*NOTE*

*Be sure to tighten counterbalancer gear at this time.*

27. See Figure 7-62. Tighten Counterbalancer Gear. Hold crankshaft with 1/2 in. drive extension and wrench while tightening counterbalancer gear fastener to 50 Nm (37 ft-lbs) plus 90°.

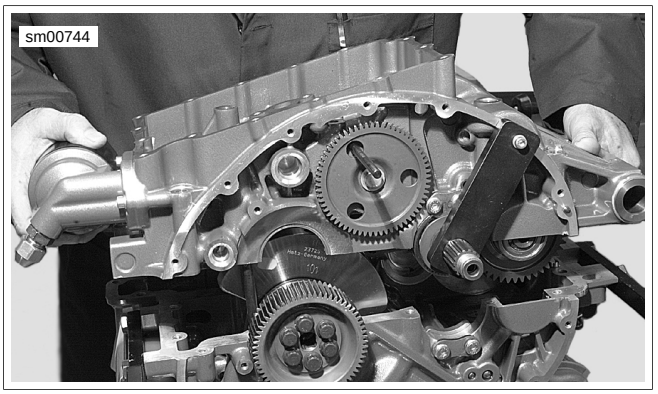



**Figure 7-59. Lower Case Over Alignment Dowels**

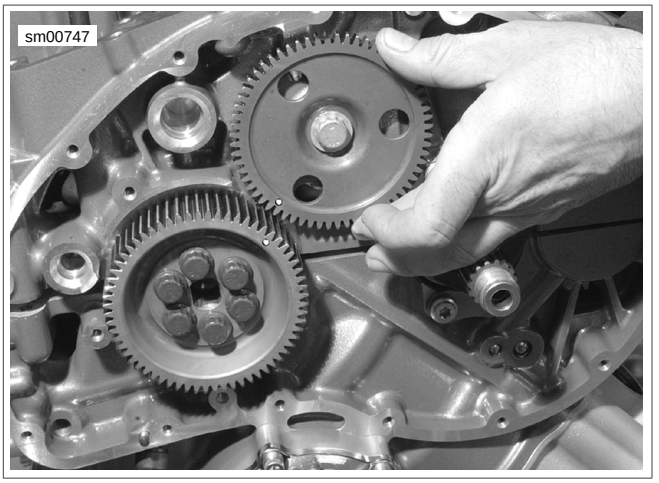



**Figure 7-60. Lower Case Over Alignment Dowels**

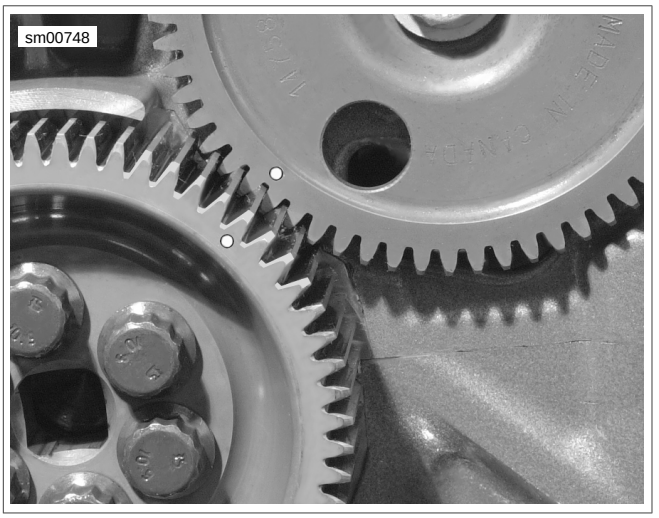



**Figure 7-61. Marks Aligned**

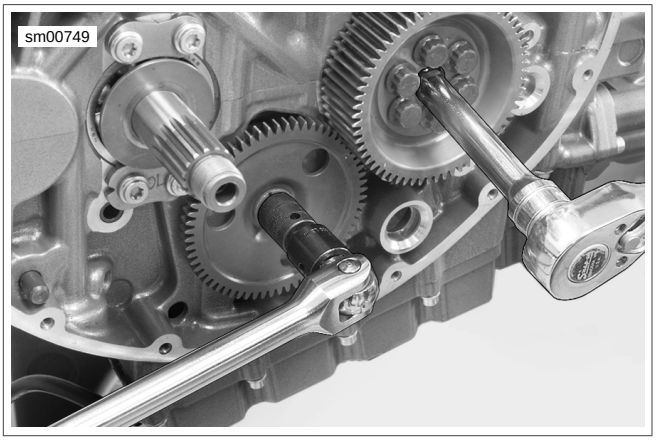



**Figure 7-62. Tighten Counterbalancer Gear**

*NOTE*

*The correct torque sequence for the case fasteners requires 2 steps. First, all 19 case fasteners including the 4 main bearing bolts are tightened to 25 Nm (18.4 ft-lbs). Second, the 4 main*

*bearing bolts are backed off one full turn, tightened to 15 Nm and then turned an additional 90°. Use the detailed procedure presented in the following steps. Refer to Table 7-5.*

28. See Figure 7-64. Tighten in sequence all 19 case fasteners to 25 Nm (18.4 ft-lbs).
29. Dab a marker next to each torqued fastener as it is tightened.
30. See Figure 7-64. Torque in sequence the 4 M10 x 150 main bearing bolts (1, 2, 3, 4) main bearing bolts in this sequence.
    a. Loosen (counterclockwise) each main bearing bolt (1, 2, 3, 4) one full turn (- 360°).
    b. See Figure 7-64. Torque in sequence each main bearing bolt (1, 2, 3, 4) to 15 Nm (11 ft-lbs).
    c. See Figure 7-63. Position the TORQUE ANGLE GAUGE (Part No. Snap-on TA360) per instruction sheet and tighten each bolt an additional quarter turn (+ 90°).

*NOTE*

*The notation for this torque sequence is written: 25 Nm - 360°,15 Nm + 90°.*

31. Dab a second mark next to each torqued main bearing bolt to identify which bolts have been tightened with the complete sequence.

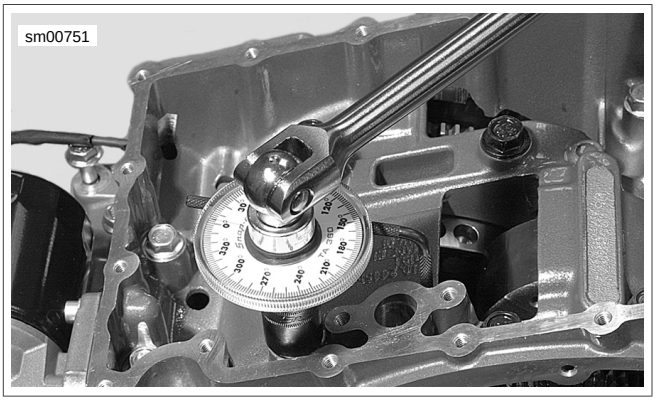
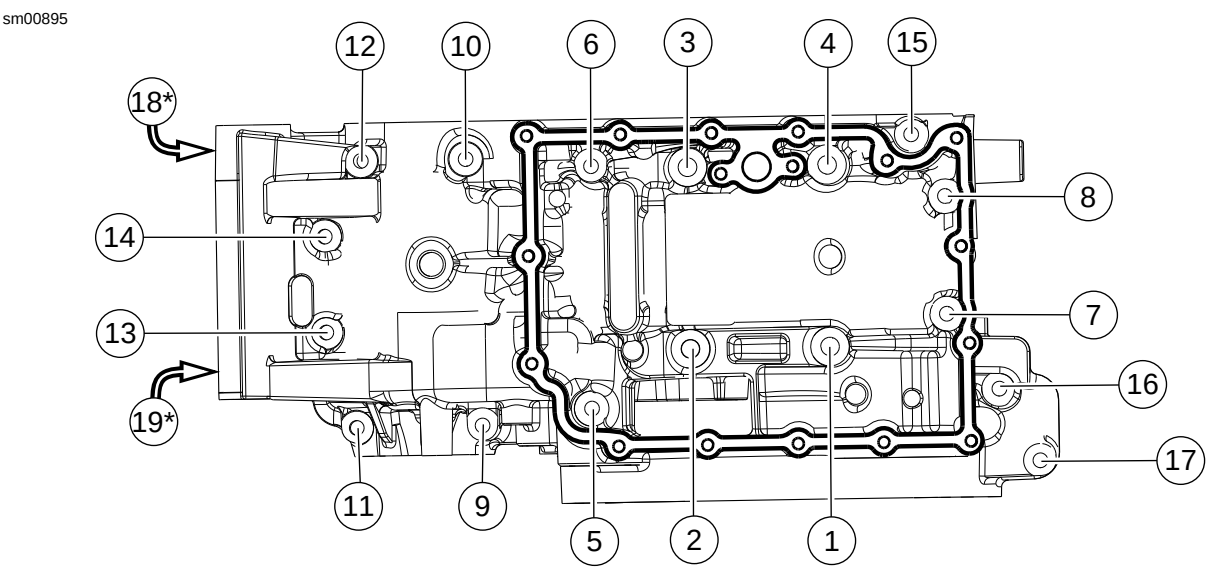



**Figure 7-63. Torque Angle Gauge**




1. **M10x150 (Part No. 968M)**
2. **M10x150 (Part No. 968M)**
3. **M10x150 (Part No. 968M)**
4. **M10x150 (Part No. 968M)**
5. **M8x120 (Part No. 973M)**
6. **M8x160 (Part No. 972M)**
7. **M8x90 (Part No. 1025M)**
8. **M8x90 (Part No. 1025M)**
9. **M8x120 (Part No. 973M)**
10. **M8x120 (Part No. 973M)**
11. **M8x40 (Part No. 970M)**
12. **M8x90 (Part No. 1025M)**
13. **M8x40 (Part No. 970M)**
14. **M8x40 (Part No. 970M)**
15. **M8x90 (Part No. 1025M)**
16. **M8x40 (Part No. 970M)**
17. **M8x40 (Part No. 970M)**
18. **M8x40 (Part No. 970M) (*insert from upper case half)**
19. **M8x40 (Part No. 970M) (*insert from upper case half)**

**Figure 7-64. Engine Case Torque Sequence**

**Table 7-5. Engine Case Fastener Torque**

| FASTENER # | TORQUE | |
|---|---|---|
| | NM | FT-LBS |
| 1 through 19 (in sequence) | 25 | 18.4 |
| 1, 2, 3, 4 (in sequence) | Backoff (-) 360° | |
| 1, 2, 3, 4 (in sequence) | 15 | 11 |
| 1, 2, 3, 4 (in sequence) | Tighten (+) 90° | |

32. See Figure 7-65. Tighten the upper and lower input bearing retainer fasteners to 23 Nm (17 ft-lbs).
33. See Figure 7-66. Install the lower case two drive sprocket flange seal retainer fasteners and tighten all four drive sprocket flange seal retainer fasteners to 23 Nm (17 ft-lbs).
34. See Figure 7-67. Place **new** oil pan gasket in position. Install oil pickup and fasteners. Tighten to 9.7 Nm (86 **in-lbs**).
35. See Figure 7-68. Install oil pan and fasteners. Tighten to 9.7 Nm (86 **in-lbs**).

*NOTE*

*For engine rebuild procedure, see steps 30-51 of 3.11 ENGINE BOTTOM END SERVICE to continue engine rebuild.*

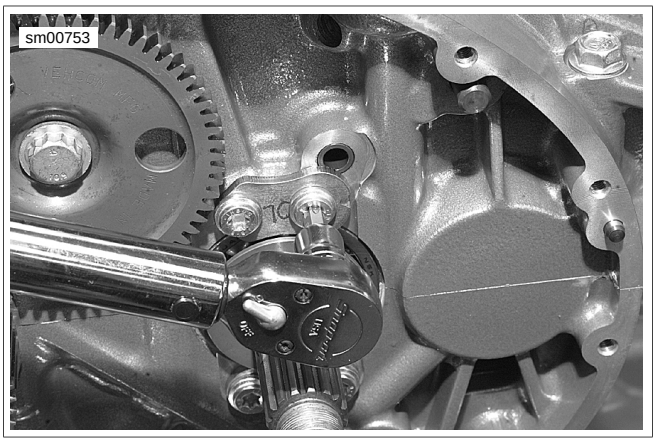



**Figure 7-65. Input Bearing Retainer**

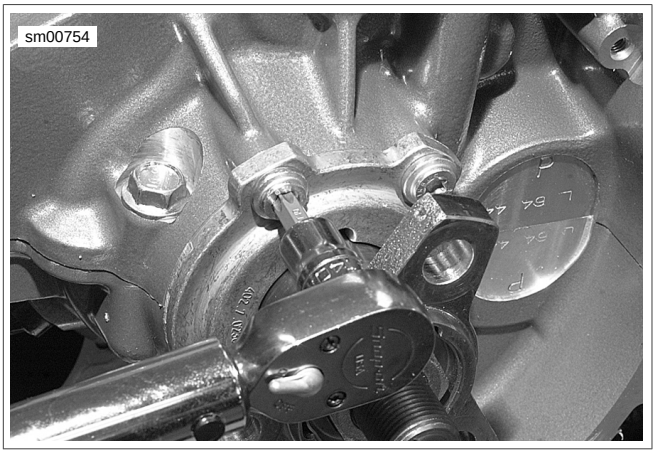



**Figure 7-66. Drive Sprocket Flange Seal Retainer**

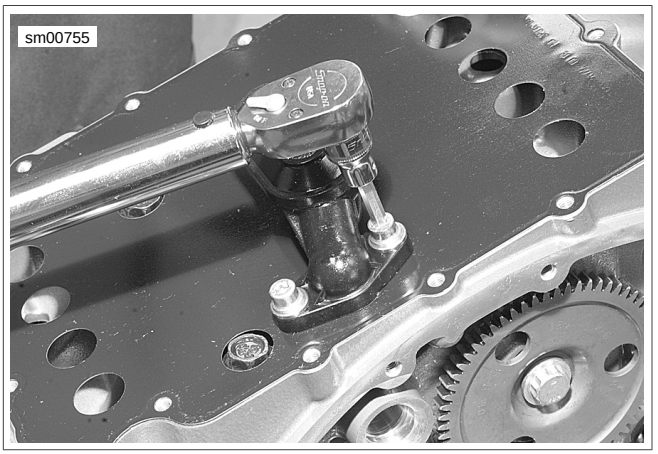



**Figure 7-67. Oil Pickup**

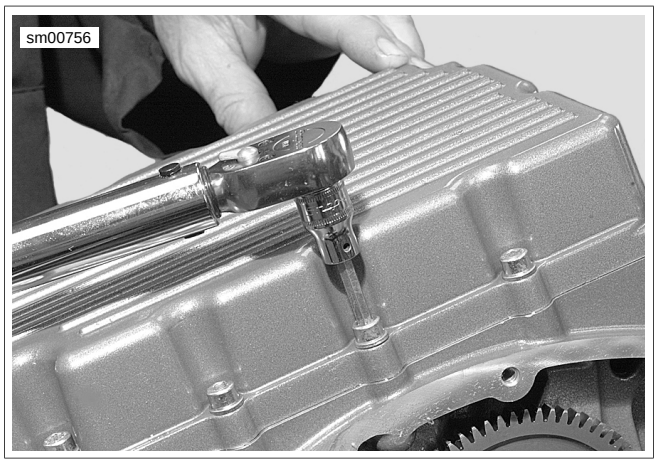



**Figure 7-68. Oil Pan**

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-34902-B | BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER |
| HD-45490 | BALANCER BEARING REMOVER/INSTALLER TOOLS |
| HD-46582 | COUNTERBALANCER BEARING INNER RACE REMOVER AND INSTALLER |
| SNAP-ON SRPC3890 | PLIERS |

*NOTE*

*In order to break counterbalancer gear loose, it is necessary to hold the counterbalancer gear with the crankshaft drive gear. Once the fastener is loose, the engine case halves can be separated. See 7.3 TRANSMISSION.*

1. See Figure 7-69. Before separating the case halves and removing the crankshaft, use a 1/2 in. drive extension and breaker bar to rotate engine clockwise until timing marks are aligned.

**CAUTION**

**Do not use Counterbalancer Alignment Pin to remove or tighten counterbalancer fastener. Pin can bend and bind in hole. (00550b)**

2. Hold crankshaft with a 1/2 in. drive extension and wrench and loosen counterbalancer gear retaining fastener.
3. See Figure 7-70. Remove fastener and gently pry counterbalancer gear from shaft. Discard gear and fastener.

*NOTE*

*The counterbalancer gear retaining fastener is one-time-use only. Always use a **new** fastener when installing counterbalancer gear.*

*NOTE*

*Use PLIERS (Part No. Snap-on SRPC3890) for removal/installation of the retaining rings.*

4. See Figure 7-71. Remove outer retaining ring.

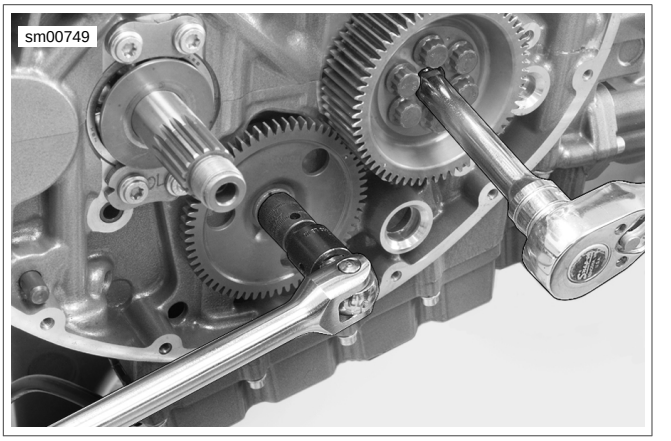



**Figure 7-69. Tighten Counterbalancer Gear**

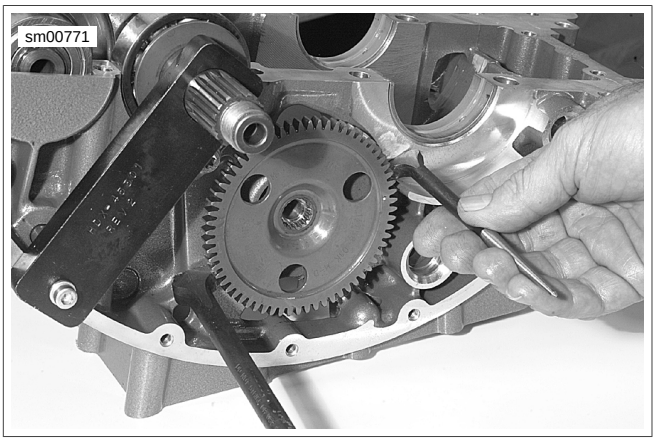



**Figure 7-70. Remove Counterbalancer Gear**

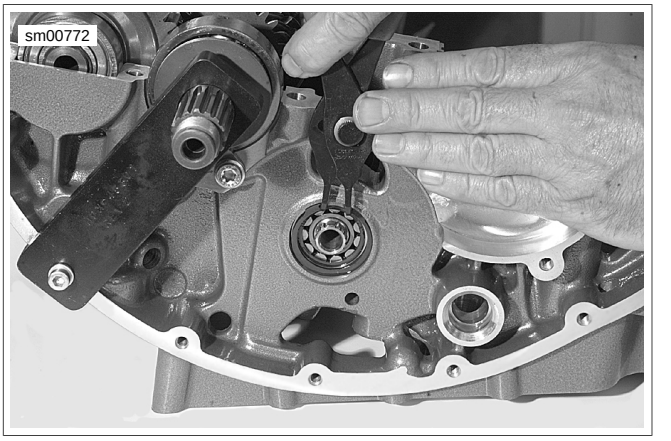



**Figure 7-71. Remove Retaining Ring**

5. See Figure 7-72. Thread end of BALANCER BEARING REMOVER/INSTALLER TOOLS (Part No. HD-45490) into balancer shaft.
6. See Figure 7-73. The counterweight must be rotated and held upright in the position shown to prevent binding

against the case. The tool will pull the outboard bearing and balancer through the case. When the bearing is free, remove tool and bearing.

7. See Figure 7-74. Counterbalancer can be removed from engine.

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

8. See Figure 7-75. Remove outboard inner retaining ring.

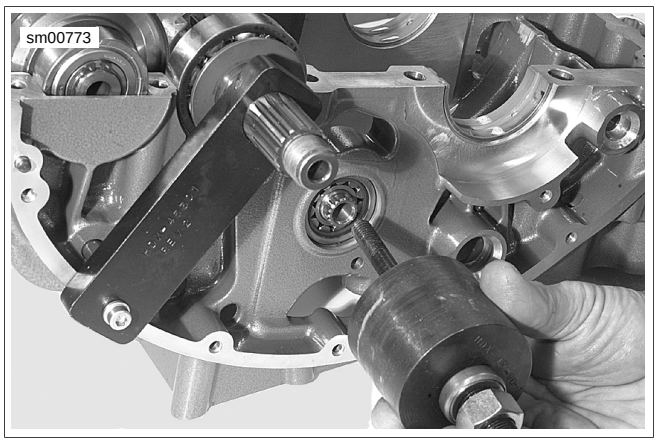



**Figure 7-72. Counterbalancer Tool**

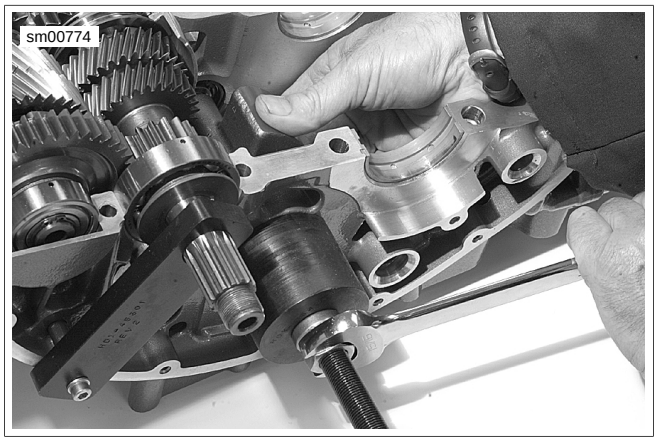



**Figure 7-73. Remove Counterbalancer Outboard Bearing**

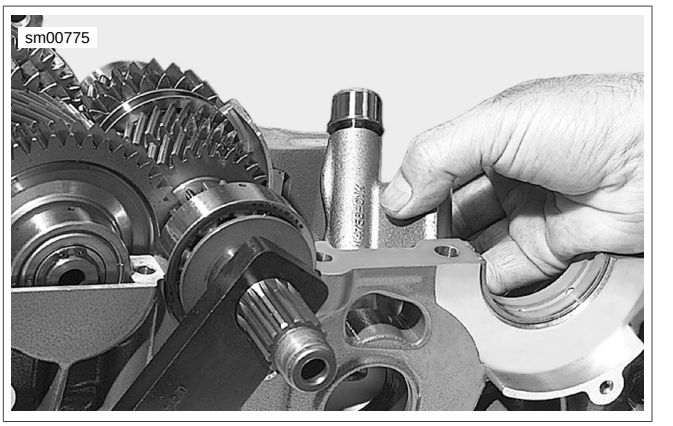



**Figure 7-74. Remove Counterbalancer**

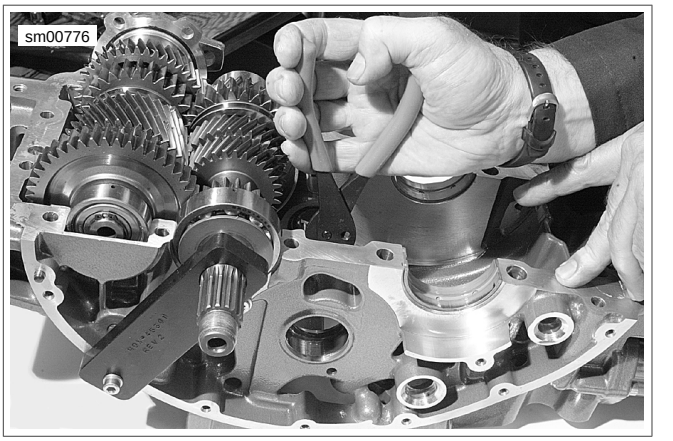



**Figure 7-75. Outboard Inner Retaining Ring**

9. See Figure 7-77. Position the bearing removal insert as shown. Note the position of the flat.
10. See Figure 7-78. Thread puller rod into insert.
11. See Figure 7-79. Hold screw end of puller and turn large nut to remove the bearing.
12. See Figure 7-76. Remove inboard retaining ring.

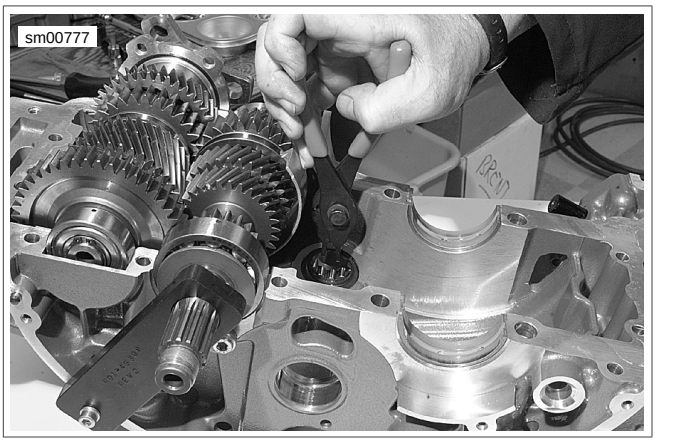



**Figure 7-76. Counterbalancer Inboard Retaining Ring**

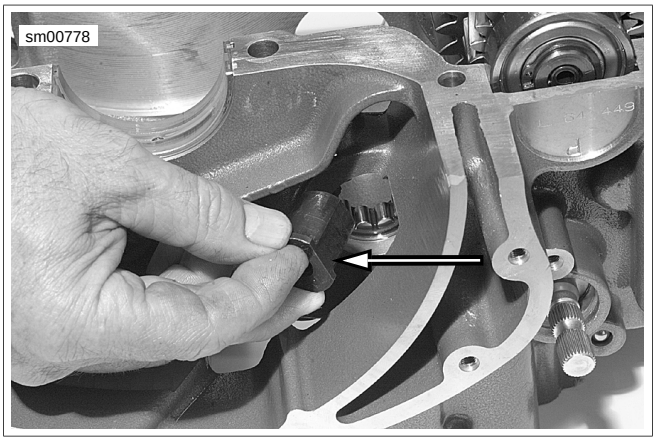



**Figure 7-77. Bearing Removal Insert**

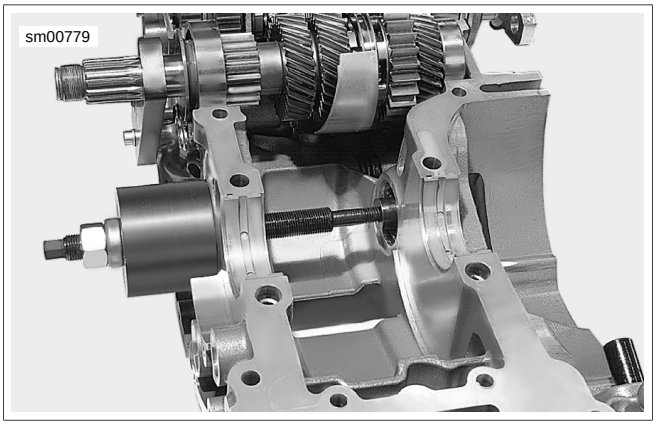



**Figure 7-78. Position Puller**

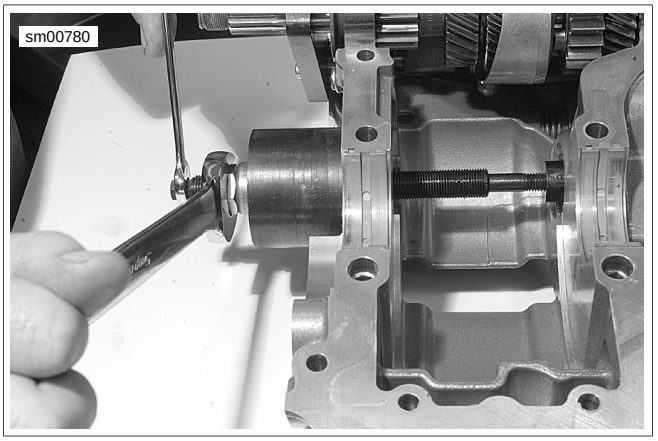



**Figure 7-79. Remove Bearing**

*NOTE*

*If counterbalancer bearings are being replaced, ALWAYS replace the inner race.*

13. See Figure 7-80. Fit the lower half of the COUNTERBALANCER BEARING INNER RACE REMOVER AND INSTALLER (Part No. HD-46582) with pin hole over back of inner race. Fit push screw into hole of lower puller half.
14. Position upper puller half around inboard inner bearing race. Slide connecting collar over the halves.
15. See Figure 7-81. Turn push screw to remove inboard bearing inner race.
16. See Figure 7-82. Using an BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER (Part No. HD-34902-B) from in the outboard end of the counterbalancer shaft, remove the outboard bearing inner race.




**Figure 7-80. Counterbalancer Bearing Inner Race Remover and Installer (HD-46582)**




**Figure 7-81. Remove Bearing Race**




**Figure 7-82. End Cap from HD-34902-B**

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45311 | COUNTERBALANCER ALIGNMENT PIN |
| HD-45490 | BALANCER BEARING REMOVER/INSTALLER TOOLS |

1. See Figure 7-83. Press **new** inner race of inboard bearing even with the end of the counterbalancer.
2. See Figure 7-84. Press **new** outboard bearing race flush against the shoulder of the balancer.

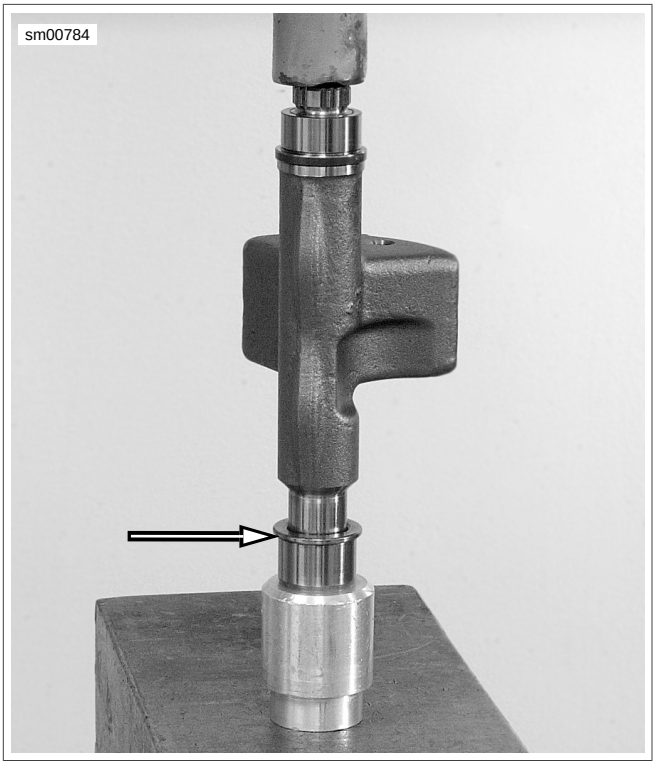



**Figure 7-83. Inboard Bearing Race**

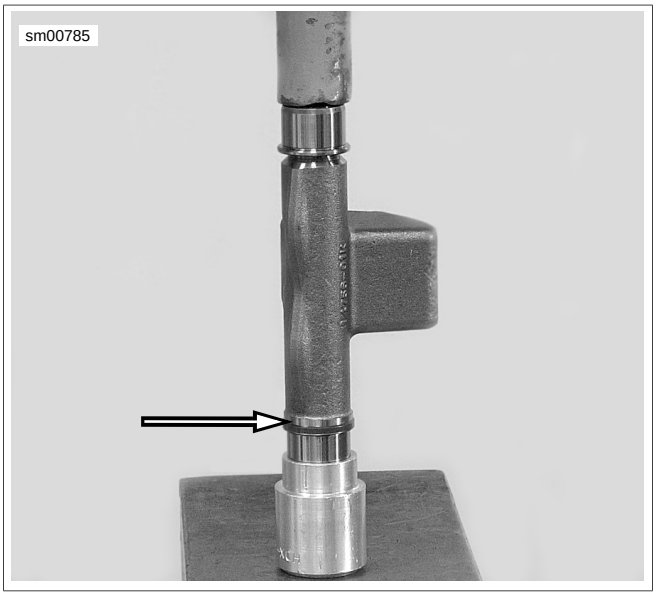
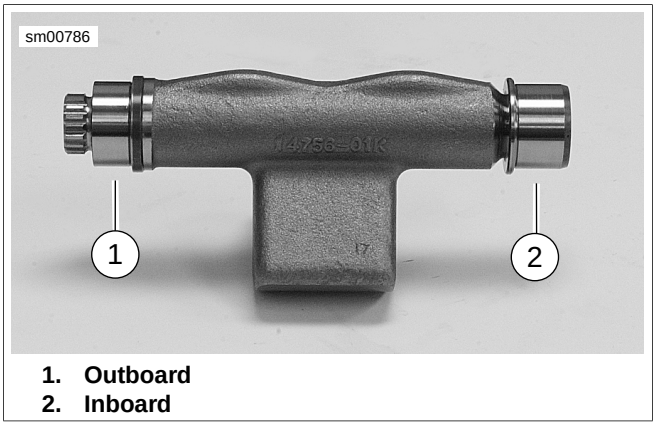



**Figure 7-84. Outboard Bearing Race**




1. **Outboard**
2. **Inboard**

**Figure 7-85. Installed Inner Races**

3. See Figure 7-85. Inboard bearing race is even with the end of the counterbalancer shaft. Outboard bearing race is fully seated against shoulder of counterbalancer.

*NOTE*

*Use Harley-Davidson Motorcycle Oil 20W50 to thoroughly lubricate bearing surfaces and case bores before bearing installation.*

*NOTE*

*When installing bearings, always drive/push against the side of the bearing with the manufactures lettering/part number.*

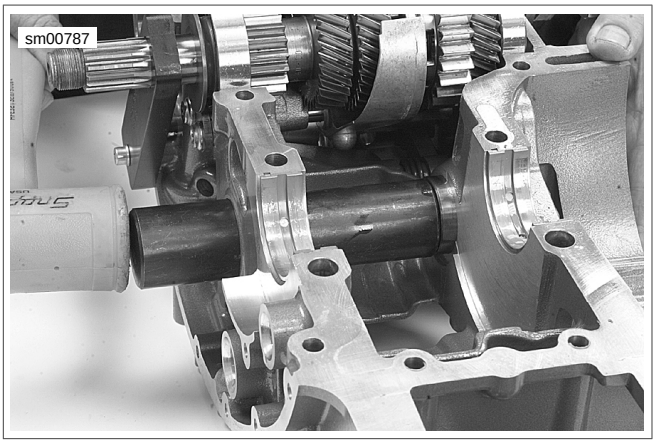



**Figure 7-86. Inner Balancer Bearing Installation**

4. See Figure 7-86. Using the bearing installer from the BALANCER BEARING REMOVER/INSTALLER TOOLS (Part No. HD-45490) drive the inner counterbalancer bearing into the case with a soft faced hammer, until the retaining ring groove is visible.
5. See Figure 7-87. Install inner retaining ring. Be certain retaining ring is fully seated.
6. See Figure 7-88. Install outboard bearing inner retaining ring. Be certain retaining ring is fully seated.

*NOTE*

*Use Harley-Davidson Motorcycle Oil 20W50 to thoroughly lubricate bearing surfaces and case bores before bearing installation process. Use Lubriplate No. 105 Assembly Grease (NAPA Part No. 765-2651) on inner races.*

7. See Figure 7-89. Position counterbalancer in case.

*NOTE*

*When installing bearings, always drive/push against the side of the bearing with the manufactures lettering/part number.*

8. See Figure 7-90. Start bearing by hand. Insert tapered guide from the BALANCER BEARING REMOVER/INSTALLER TOOLS (Part No. HD-45490).

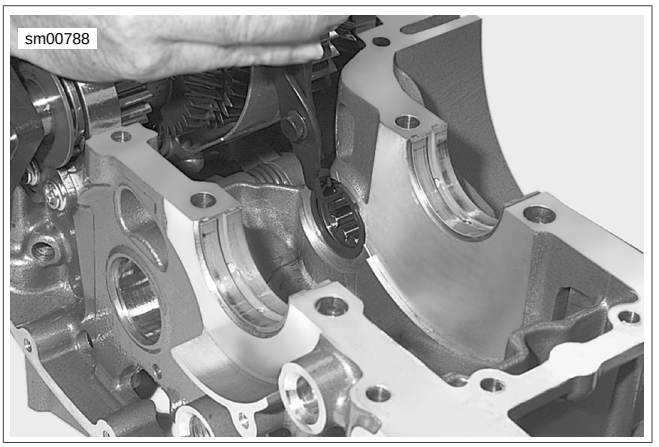



**Figure 7-87. Inner Balancer Bearing Installation**

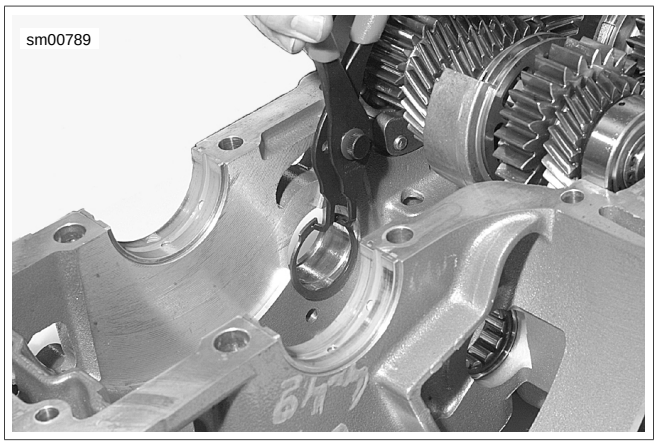



**Figure 7-88. Outboard Bearing Inner Retaining Ring**

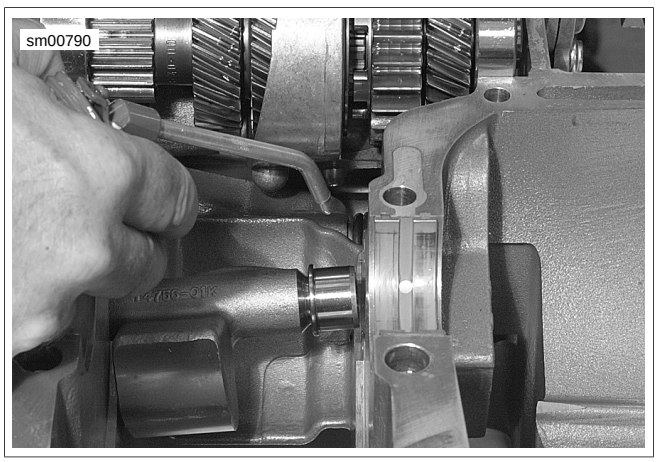



**Figure 7-89. Position Counterbalancer**

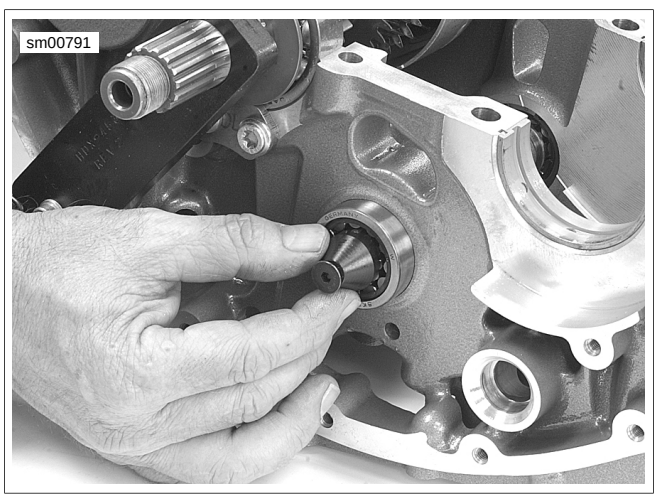



**Figure 7-90. Insert Tapered Guide**

9. See Figure 7-91. Use the driver from the BALANCER BEARING REMOVER/INSTALLER TOOLS (Part No. HD-45490). Drive the bearing in with a soft faced hammer until the retaining ring groove is exposed.

10. See Figure 7-92. Install **new** out board retaining ring. Be certain retaining ring is fully seated in the case groove.

*NOTE*

*The counterbalancer gear can be installed on the balancer shaft with the counterbalancer gear fastener loosely holding the counterbalancer in place. The counterbalancer is either timed to the crankshaft during the assembly of the case halves, or after the case halves have been assembled.*

11. See Figure 7-93. Position balancer shaft master tooth at 11 o'clock.

12. Insert COUNTERBALANCER ALIGNMENT PIN (Part No. HD-45311).

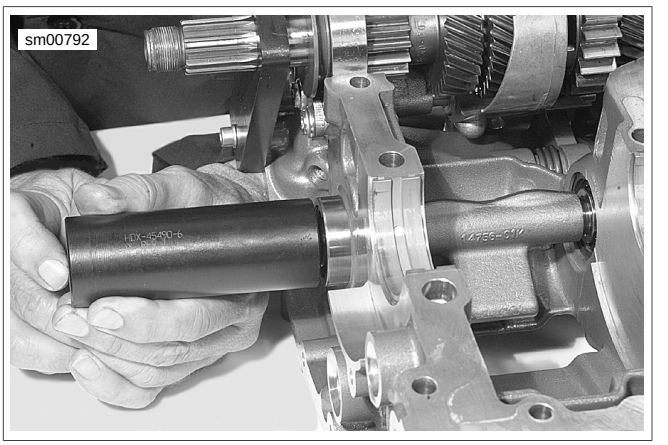



**Figure 7-91. Outboard Bearing Installation**

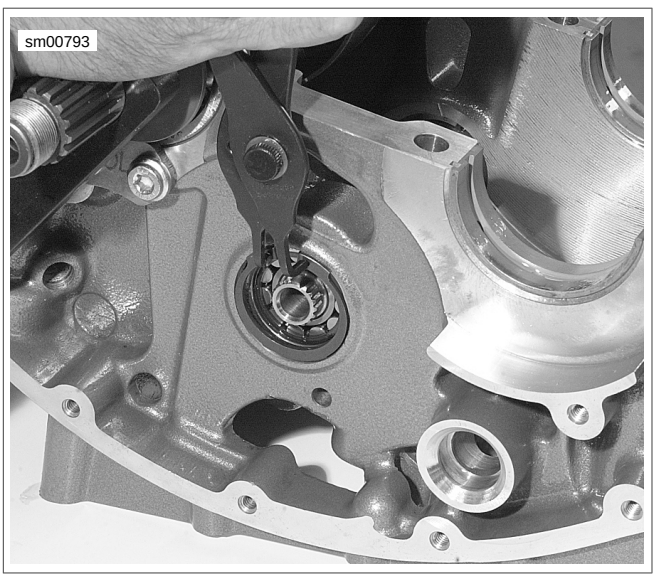



**Figure 7-92. Outboard Retaining Ring Installation**

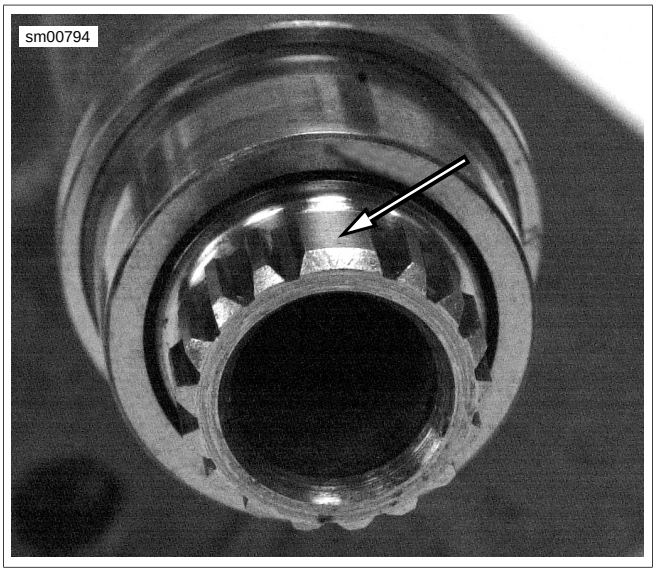



**Figure 7-93. Counterbalancer Shaft Master Tooth**

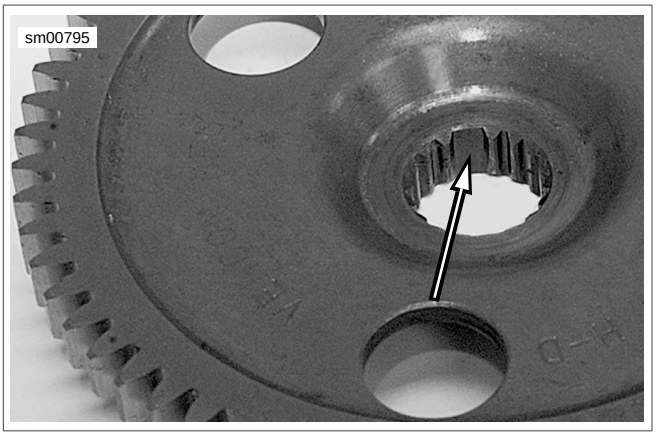



**Figure 7-94. Counterbalancer Gear Master Tooth Flat**

13. See Figure 7-95. Position counterbalancer gear with timing marks aligned to crankshaft drive gear.
14. See Figure 7-94. Align the master tooth flat with the corresponding master tooth on the balancer shaft.
15. Gently rock crankshaft until counterbalancer shaft master tooth engages counterbalancer gear master tooth flat and gear slides onto shaft. Gear should seat with hand pressure.

**CAUTION**

**Do not use Counterbalancer Alignment Pin to remove or tighten counterbalancer fastener. Pin can bend and bind in hole. (00550b)**

16. Remove COUNTERBALANCER ALIGNMENT PIN (Part No. HD-45311).
17. Install a **new** counterbalancer gear fastener.
18. See Figure 7-96. Hold crankshaft with 1/2 in. drive extension and wrench while tightening counterbalancer gear fastener to 50 Nm (37 ft-lbs) plus 90°.




**Figure 7-95. Timing Marks**

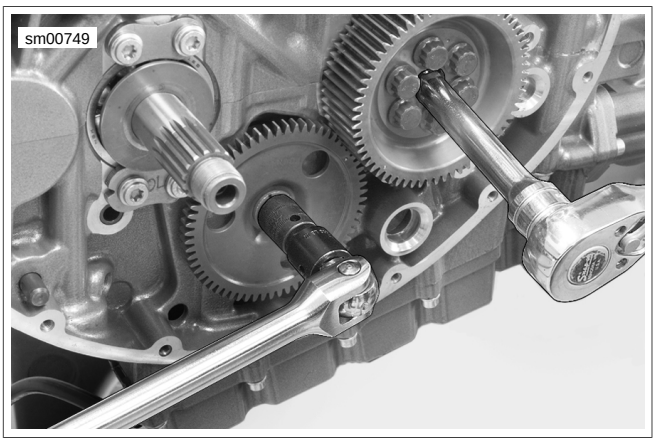



**Figure 7-96. Tighten Counterbalancer Gear**

## GENERAL

This procedure is shown with the engine removed. The shift shaft and seal may be replaced without removing the engine from the chassis.

## REMOVAL

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

1. See Figure 7-97. Remove the outer retaining ring (zinc plated).
2. See Figure 7-98. Drill small hole in the shift shaft seal. Thread sheet metal screw into the hole.
3. See Figure 7-99. Gently pry seal from engine case.

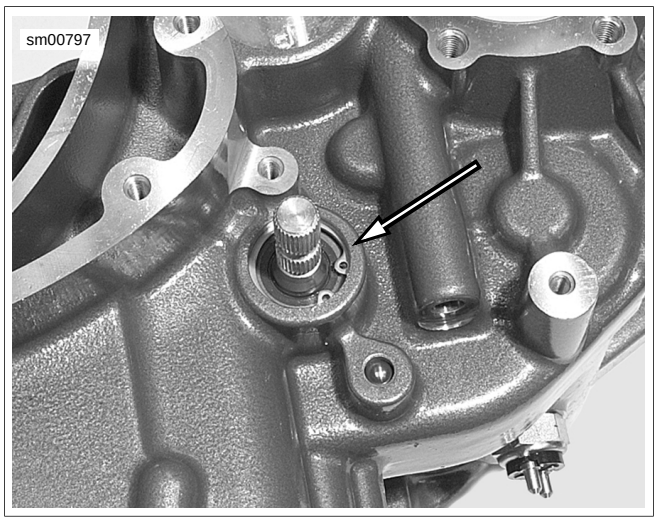



**Figure 7-97. Shift Shaft Outer Retaining Ring**

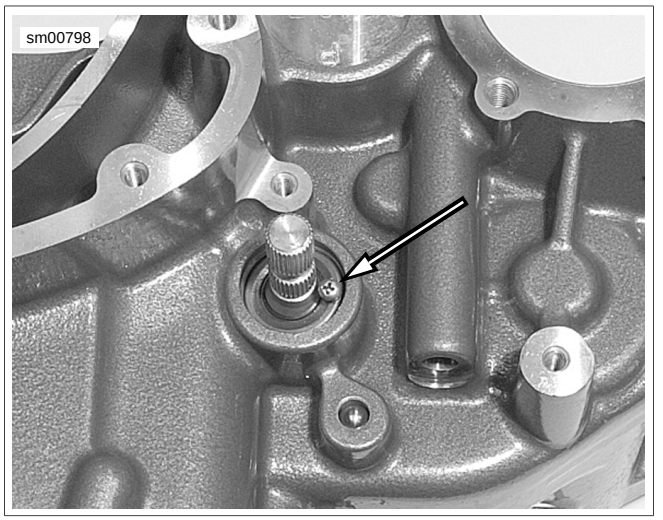



**Figure 7-98. Shift Shaft Seal**

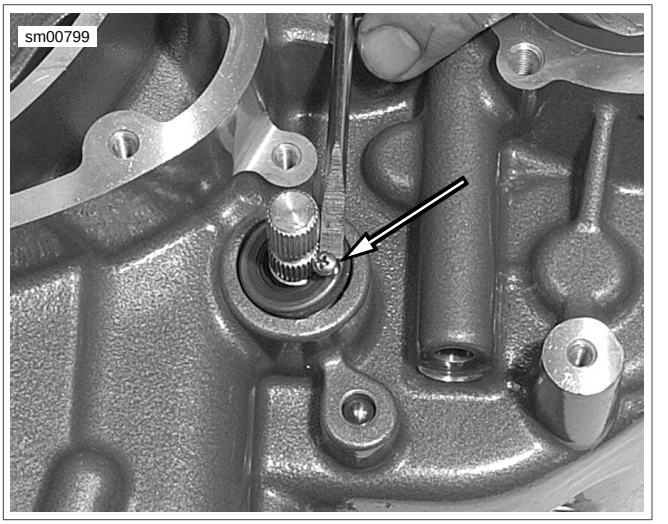



**Figure 7-99. Remove Shift Shaft Seal**

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

4. See Figure 7-100. With the shaft seal removed, the inner retaining ring (black) is exposed. Remove the retaining ring.
5. Remove shift shaft using hand effort.
6. See Figure 7-101. The shift actuator is spring loaded and will move away from alignment with the case hole when the shift shaft is removed.

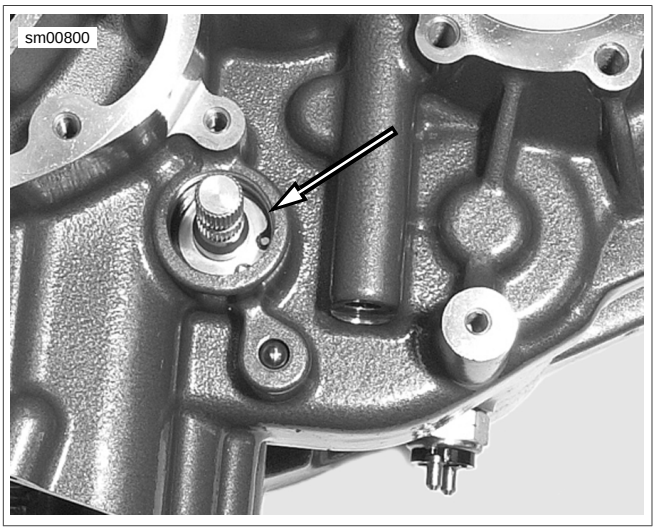



**Figure 7-100. Shift Shaft Inner Retaining Ring**

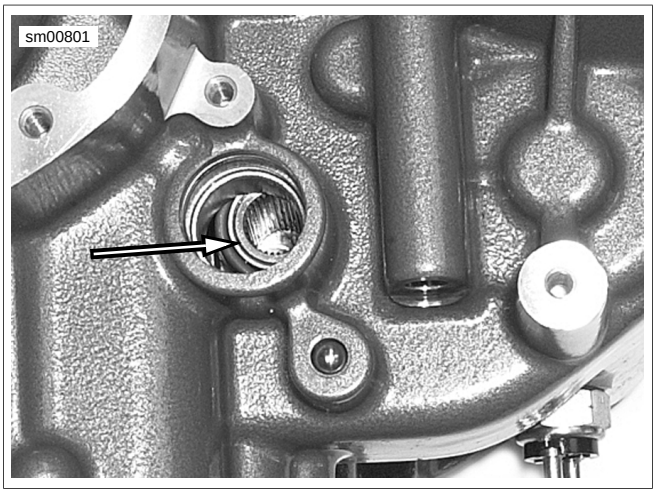



**Figure 7-101. Shift Actuator**

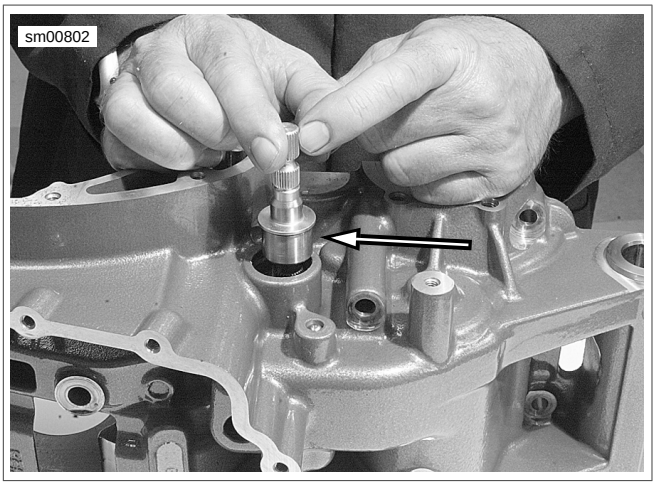



**Figure 7-102. Shift Shaft Installation**

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45337 | SHIFT SHAFT SEAL INSTALLER |

1. See Figure 7-102. To insert shift shaft, use leading end of shift shaft to engage the shift actuator. Using hand pressure, center the shift shaft to engage the actuator splines. Seat shift shaft deep enough to expose inner retaining ring groove.

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

*NOTE*

*The inner (black) retaining ring and the outer (zinc plated) retaining ring are different in size by 1 mm.*

2. Insert inner retaining ring (black).
3. See Figure 7-103. Lubricate shift shaft seal with Harley-Davidson Motorcycle Oil 20W50 and insert using SHIFT SHAFT SEAL INSTALLER (Part No. HD-45337).
4. Install outer retaining ring (zinc plated).

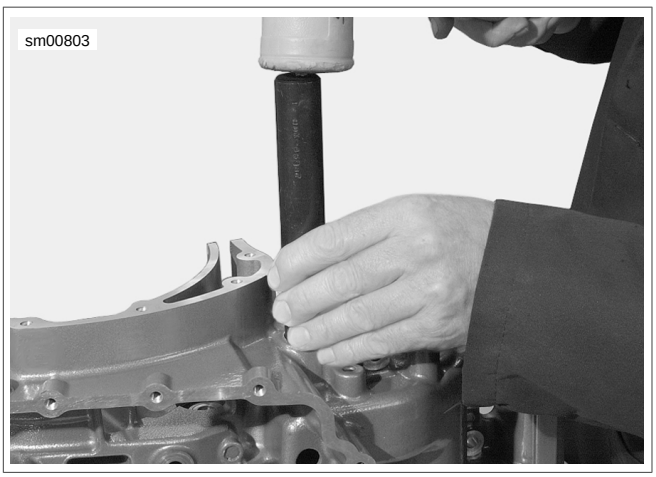



**Figure 7-103. Shift Shaft Seal Installation**

## GENERAL

This procedure starts with the input shaft and output shaft removed from the engine. See 3.10 UPPER AND LOWER CRANKCASE SEPARATION for removal of input shaft and output shaft.

## DISASSEMBLY - 2ND GEAR END

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45331-A | FINAL DRIVE SPROCKET FLANGE LOCKING TOOL |
| HD-45331-A | FINAL DRIVE SPROCKET FLANGE LOCKING TOOL |
| HD-45332 | FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER |
| SNAP-ON CJ2001 | METRIC BOLT GRIP PULLER SET |
| SNAP-ON CJ2001 | METRIC BOLT GRIP PULLER SET |

### Bearing Removal - 2nd Gear End

1. See Figure 7-104. Remove lock ring from output flange nut.
2. See Figure 7-105. Place output shaft in FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A) to remove the output shaft nut, use a 30 mm socket cut down to 39.6 mm (1.56 in.) to clear the flange.

*NOTE*

*Output flange nut is one time use only, but do not discard at this time. Retain removed nut to pull flange on shaft during assembly.*

3. See Figure 7-106. Obtain three 3/8 x5 inch bolts with washers and nuts and install a METRIC BOLT GRIP PULLER SET (Part No. Snap-on CJ2001) onto the flange and shaft. Remove output shaft drive flange and seal retainer.
4. See Figure 7-107. Remove output shaft bearing.

*NOTE*

*If no further disassembly of this end is needed, go to step 5. If further disassembly is needed, go to step 13.*

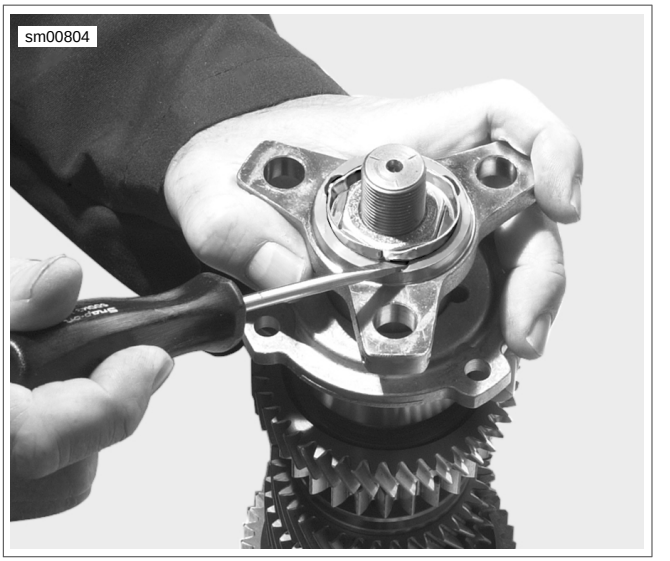



**Figure 7-104. Output Shaft Lock Ring**

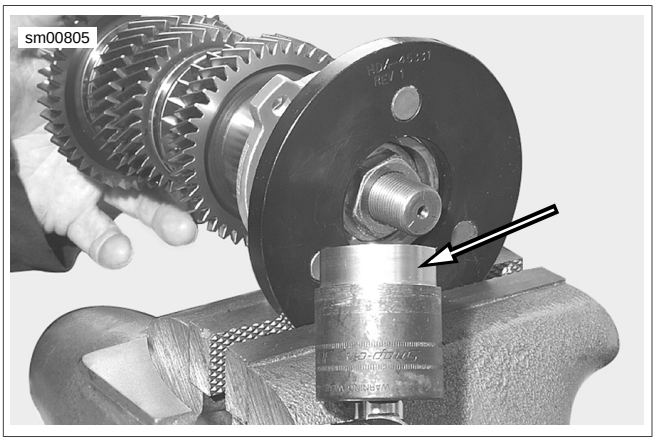



**Figure 7-105. Modify Socket for Output Nut Removal**

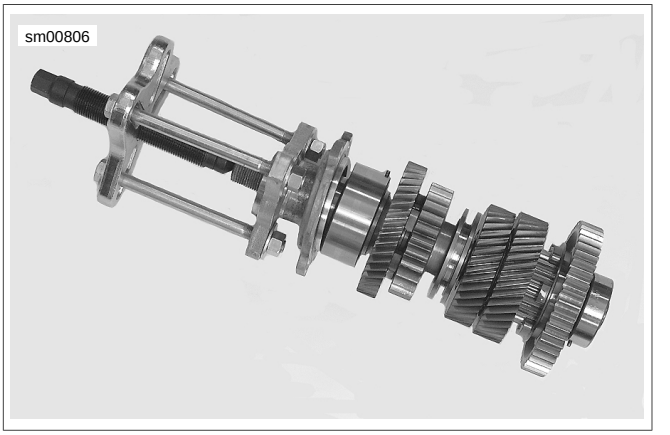



**Figure 7-106. Removing Output Drive Flange**

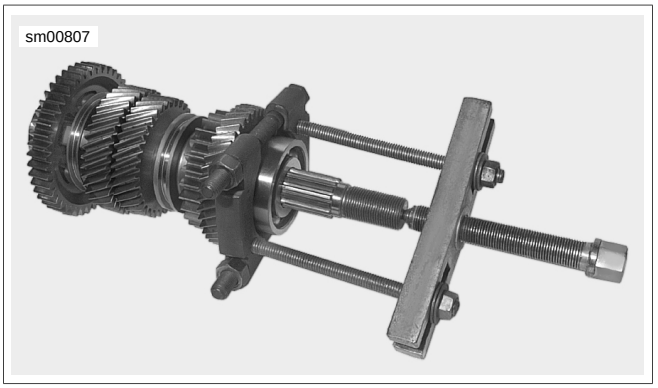


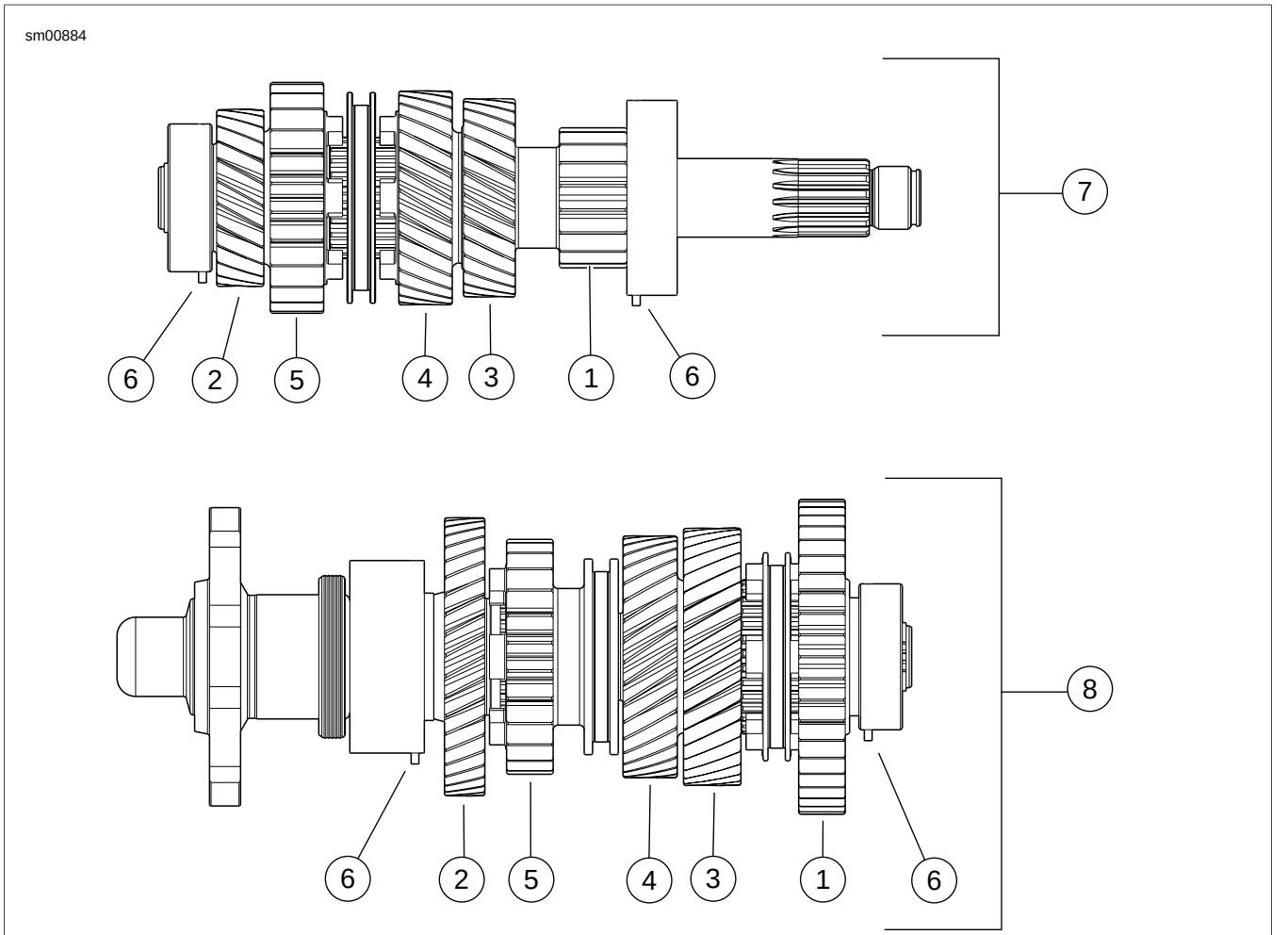

**Figure 7-107. Output Shaft Bearing**

## Bearing Installation - 2nd Gear End

1. See Figure 7-109 and Figure 7-108. Lubricate **new** bearing. Position bearing on shaft with bearing alignment pin offset toward gears and press onto shaft. Use a pressing ring so installation force is on the inner race only.




**Figure 7-108. Output Shaft Bearing**




1. **1st gear**
2. **2nd gear**
3. **3rd gear**
4. **4th gear**
5. **5th gear**
6. **Bearing alignment pins (Install with offset toward gears)**
7. **Input shaft**
8. **Output shaft**

**Figure 7-109. Transmission Input Shaft and Output Shaft Assemblies**

2. See Figure 7-110. Replace flange seal and o-ring. Lubricate the flange seal with Harley-Davidson Motorcycle Oil 20W50.
3. See Figure 7-111. Slide seal retainer on the output flange.
4. Place output shaft in FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (Part No. HD-45331-A) to install the output shaft nut.

*NOTE*

*Do not attempt to drive flange on with a hammer. Damage to the output shaft can result.*

5. Use the **old** output shaft nut to pull the output flange on the shaft.
6. See Figure 7-112. Remove and discard the **old** output shaft nut.




1. **Drive flange seal**
2. **O-ring**

**Figure 7-110. Seal Retainer**

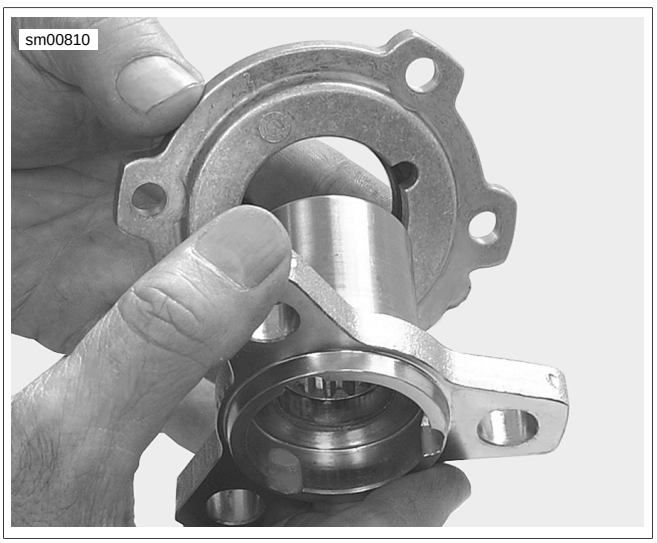



**Figure 7-111. Seal Retainer and Output Flange**

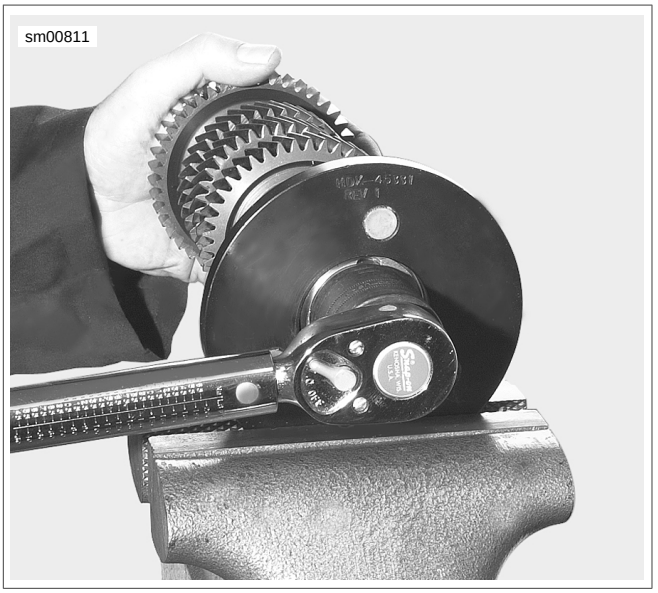
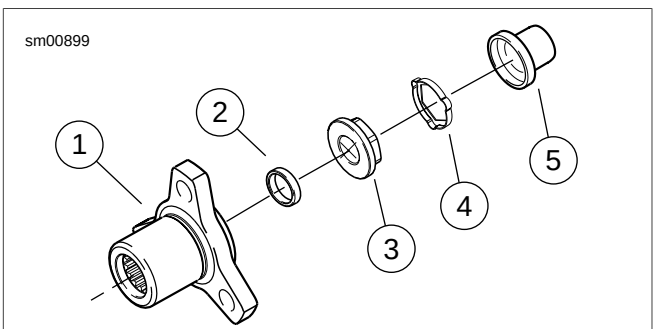



**Figure 7-112. Remove/Tighten Output Shaft Nut**

7. See Figure 7-113. Install a **new** o-ring (2) behind a **new** drive sprocket flange nut (3) and install the **new** flange nut (3). Tighten nut to 160 Nm (118 ft-lbs).
8. Position lock ring (4) over flange nut (3).
9. See Figure 7-114. With three 3/8 x5 inch bolts with washers and nuts and install a METRIC BOLT GRIP PULLER SET (Part No. Snap-on CJ2001) onto the flange and shaft. Turn screw down against the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (Part No. HD-45332) to crimp lock ring in position.
10. Cap nut.

*NOTE*

*Never use a hammer to hit on the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (Part No. HD-45332). Damage to output shaft bearing could result.*




1. **Output shaft flange**
2. **O-ring**
3. **Flange nut**
4. **Lock ring**
5. **Plastic cap**

**Figure 7-113. Output Shaft Components**

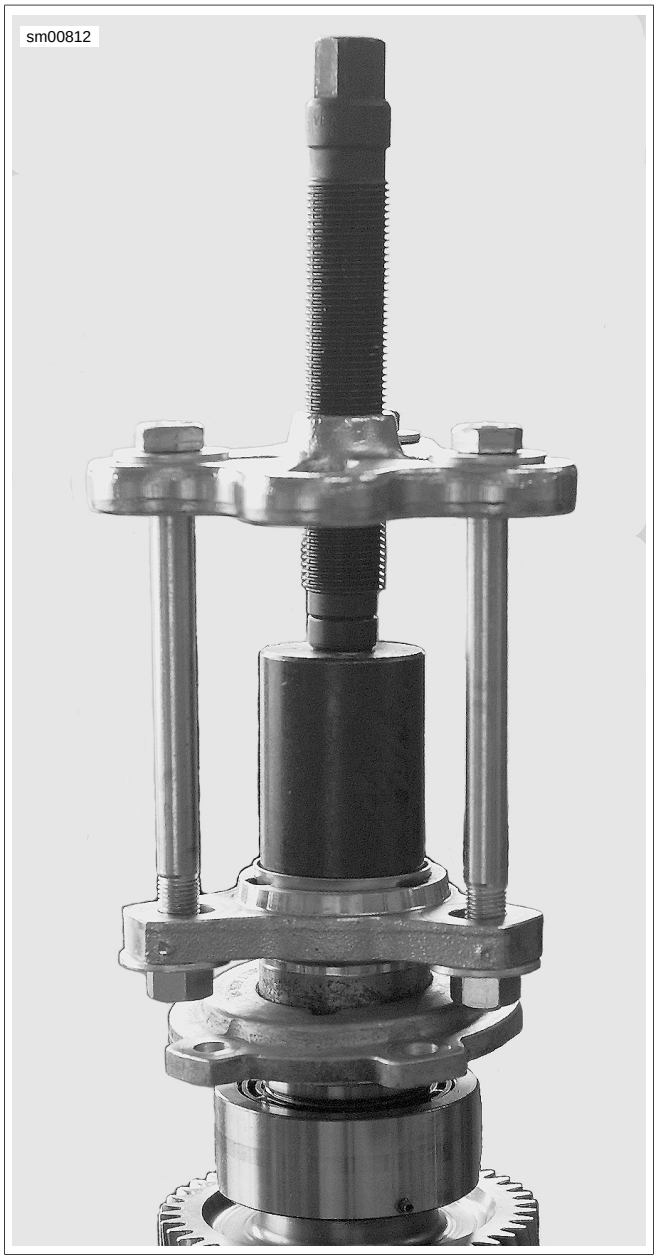



**Figure 7-114. Crimping Output Shaft Nut Lock-Ring**

11. See Figure 7-115. Remove ground washer.
12. See Figure 7-116. Remove 2nd gear.
13. See Figure 7-117. Remove split cage bearing and hardened washer.
14. See Figure 7-118. Remove 5th gear.

*NOTE*

*Fourth gear is part of output shaft and is not removable. Damage to 4th gear requires replacement of the output shaft.*

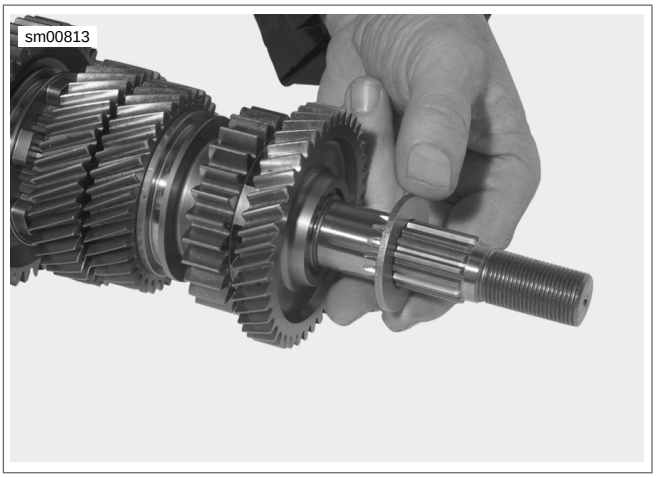



**Figure 7-115. Remove Ground Washer**

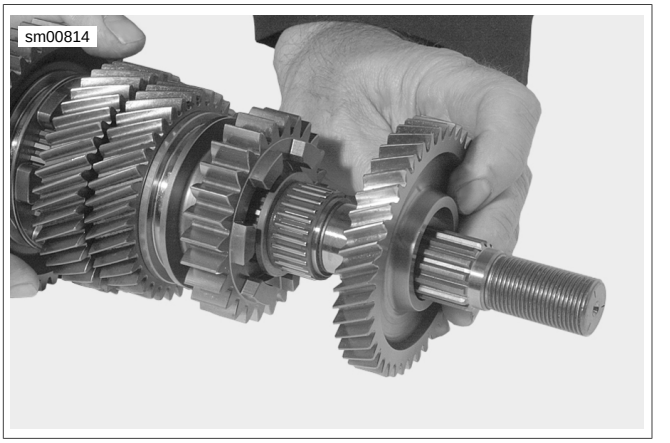



**Figure 7-116. 2nd Gear**

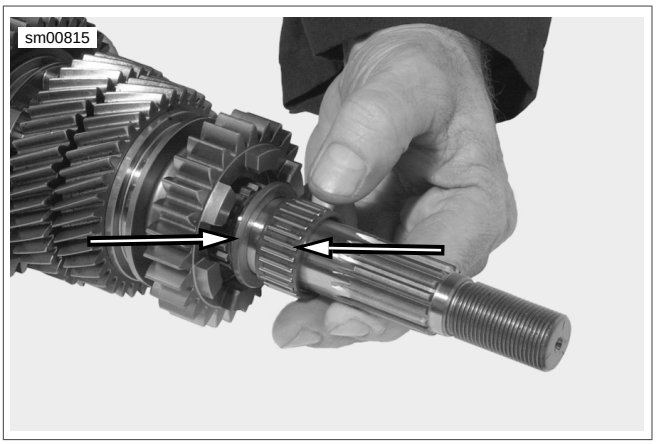



**Figure 7-117. Bearing and Washer**

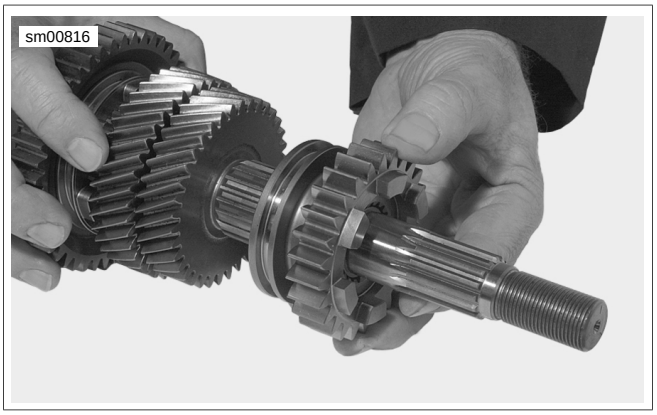



**Figure 7-118. 5th Gear**

## ASSEMBLY - 2ND GEAR END

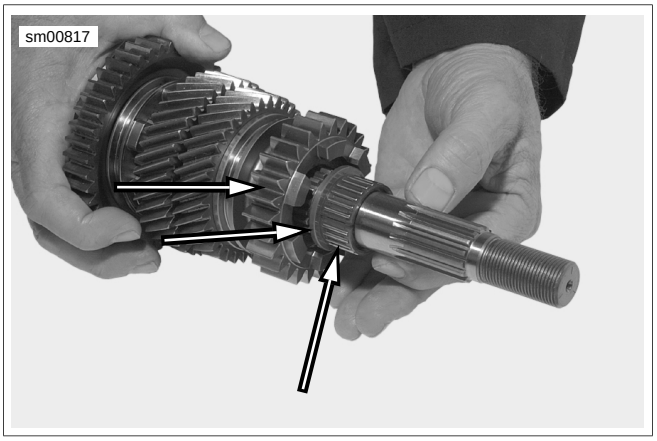



**Figure 7-119. 5th Gear Installation**

1. See Figure 7-119. Install 5th gear ground washer and split cage bearing.

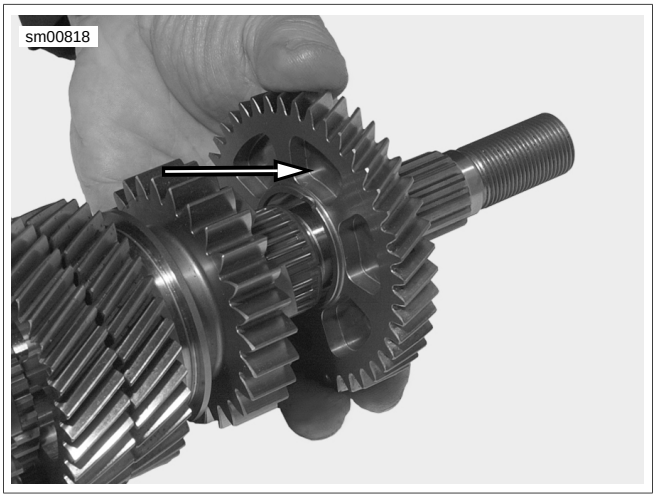



**Figure 7-120. 2nd Gear Installation**

2. See Figure 7-120. Install 2nd gear. Note 2nd gear pockets are installed toward the 5th gear engagement dogs.

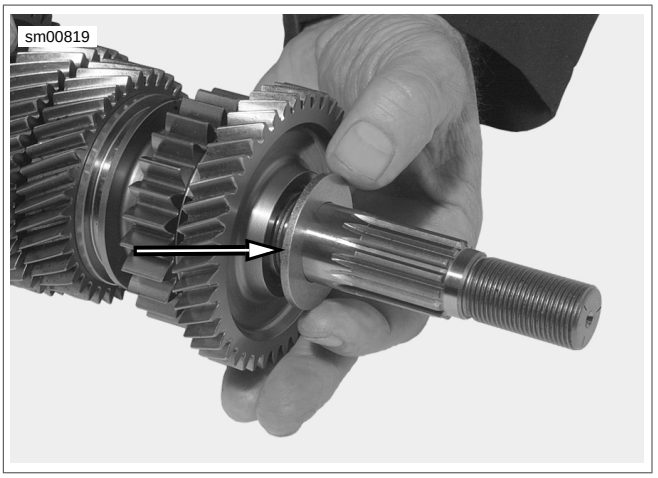



**Figure 7-121. Hardened Washer**

3. See Figure 7-121. Install hardened washer.
4. To complete output shaft assembly - 2nd gear end, go to 7.7 INPUT SHAFT, Disassembly - 2nd Gear End.

## Bearing Removal - 1st Gear End

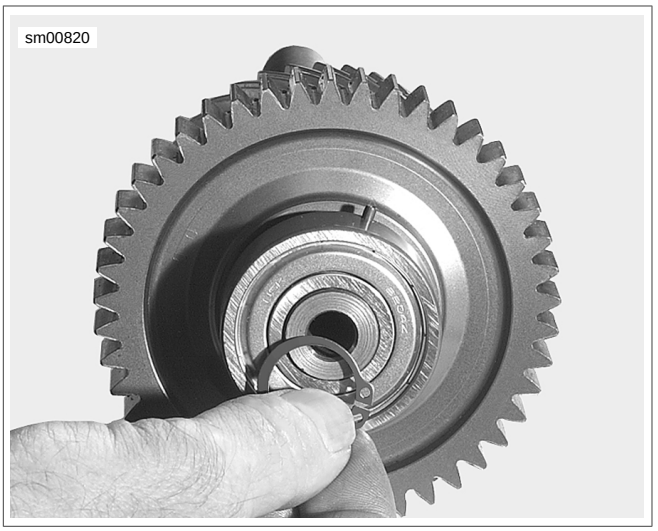



**Figure 7-122. 1st Gear Bearing Retaining Ring**

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

5. See Figure 7-122. Remove the retaining ring from the 1st gear bearing end of the output shaft.

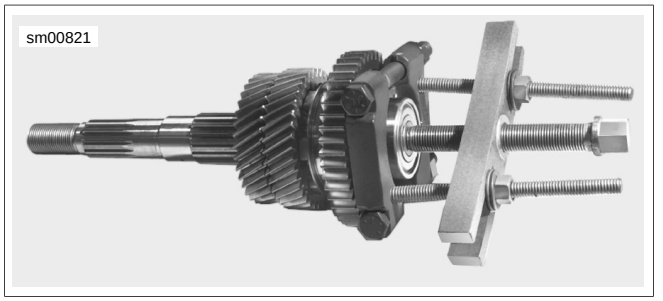



**Figure 7-123. 1st Gear Bearing Removal**

6. See Figure 7-123. Remove and discard 1st gear bearing.

*NOTE*

*Once removed, transmission bearings MUST be replaced.*

*NOTE*

*If no further disassembly of this end is needed, go to step 7. If further disassembly of this end is needed, go to step 8.*

## Bearing Installation - 1st Gear End

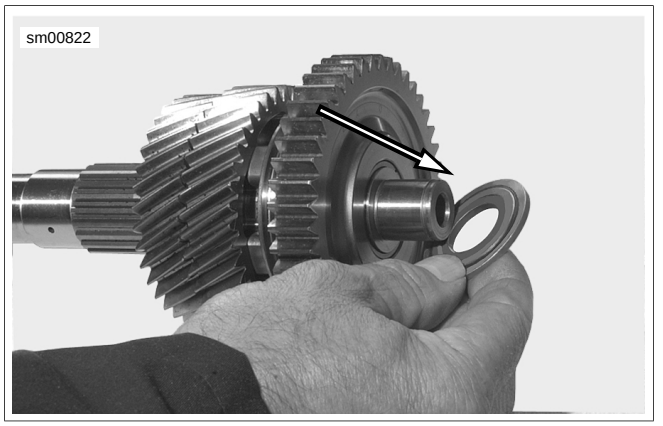



**Figure 7-124. Thrust Washer**

7. See Figure 7-124. Check position of stepped thrust washer. Step should face 1st gear, flat side toward bearing.

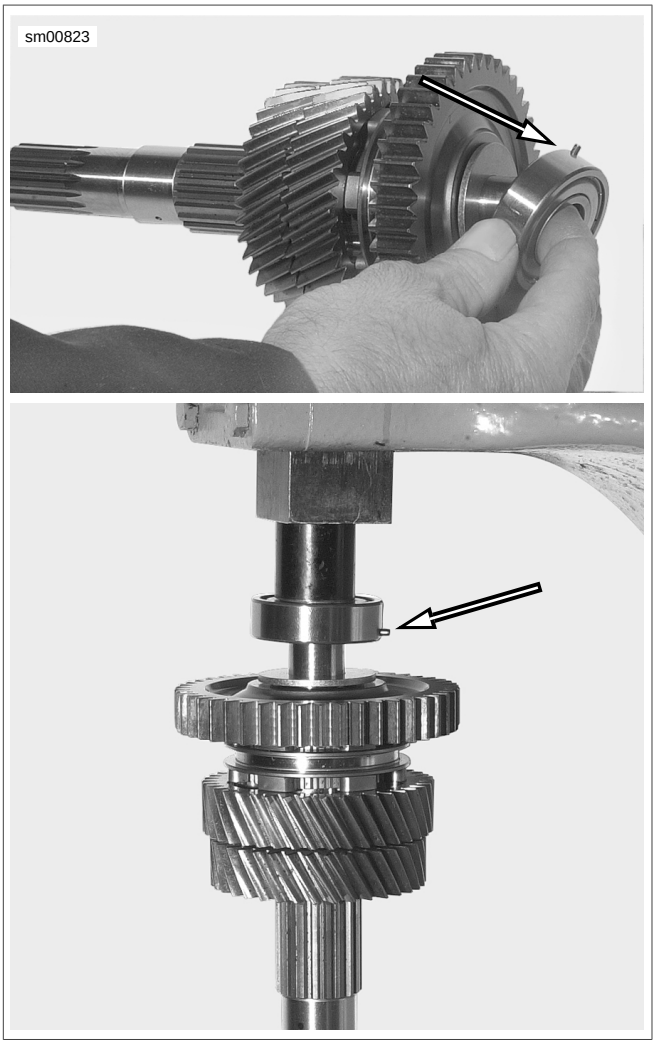



**Figure 7-125. 1st Gear Bearing Installation**

8. See Figure 7-125. Install **new** bearing with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

9. Install retaining ring.
10. See Figure 7-109. Remove stepped washer and 1st gear (1).

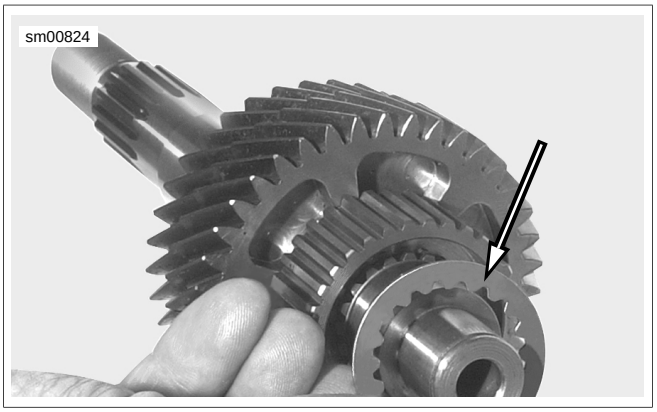



**Figure 7-126. Splined Washer**

11. See Figure 7-126. Remove splined washer.

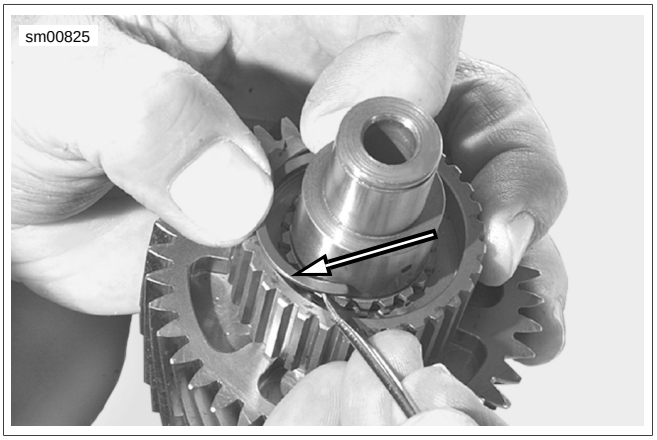



**Figure 7-127. Half Moon Keepers**

12. See Figure 7-127. Remove the half moon keepers.
13. See Figure 7-128. Remove the splined slider.
14. See Figure 7-129. Remove half moon keepers.
15. See Figure 7-130. Remove 3rd gear and split cage needle bearing.

*NOTE*

*Fourth (4th) gear is part of the output shaft and is not removable.*




**Figure 7-128. Splined Slider**

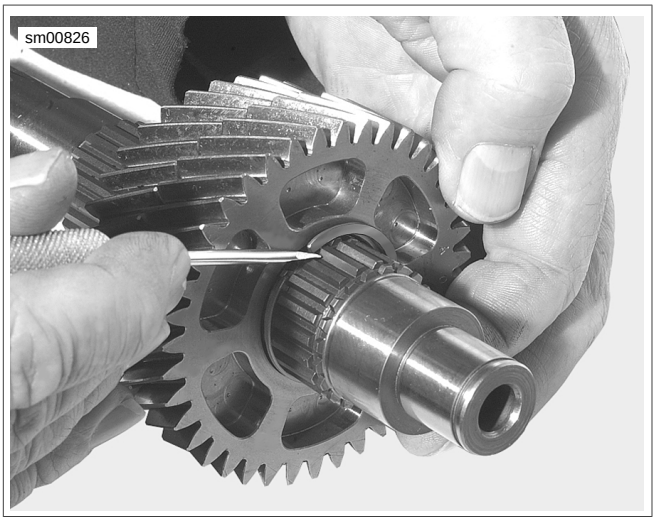



**Figure 7-129. Half Moon Keepers**

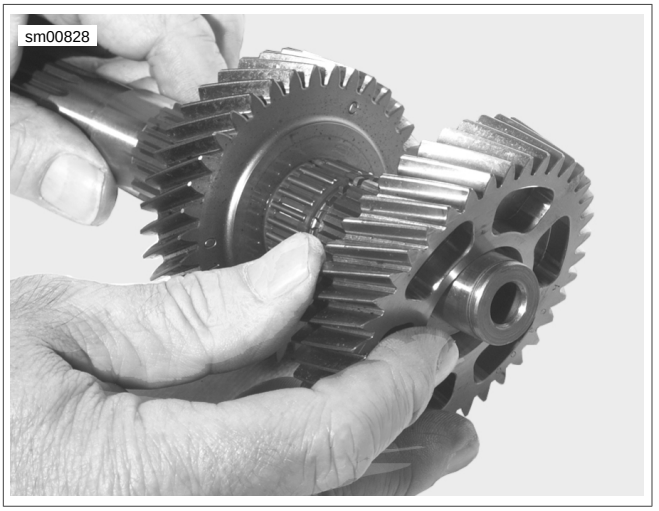



**Figure 7-130. 3rd Gear**

## ASSEMBLY - 1ST GEAR END

Carefully clean and inspect parts to be reused. Examine gears for cracks, chipping and excessive wear.

1. See Figure 7-131. Install split cage needle bearing. Install 3rd gear.
2. See Figure 7-133. Install half moon keepers.
3. See Figure 7-133. Install splined slider.
4. See Figure 7-134. Install half moon keepers.

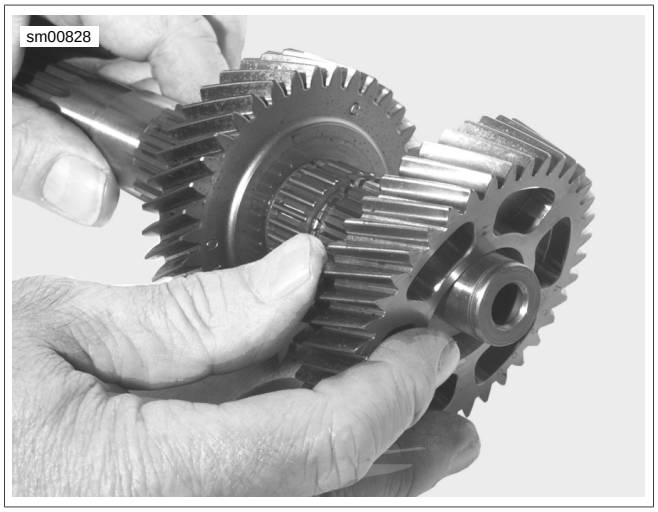



**Figure 7-131. 3rd Gear**




**Figure 7-132. Half Moon Keepers**




**Figure 7-133. Splined Slider**




**Figure 7-134. Half Moon Keepers**

5. See Figure 7-135. Install splined thrust washer with flat side out as shown.
6. See Figure 7-136. Install shift fork slider.
7. See Figure 7-137. Install 1st gear.
8. To complete output shaft assembly - 1st gear end, go to Bearing Installation - 1st Gear End.

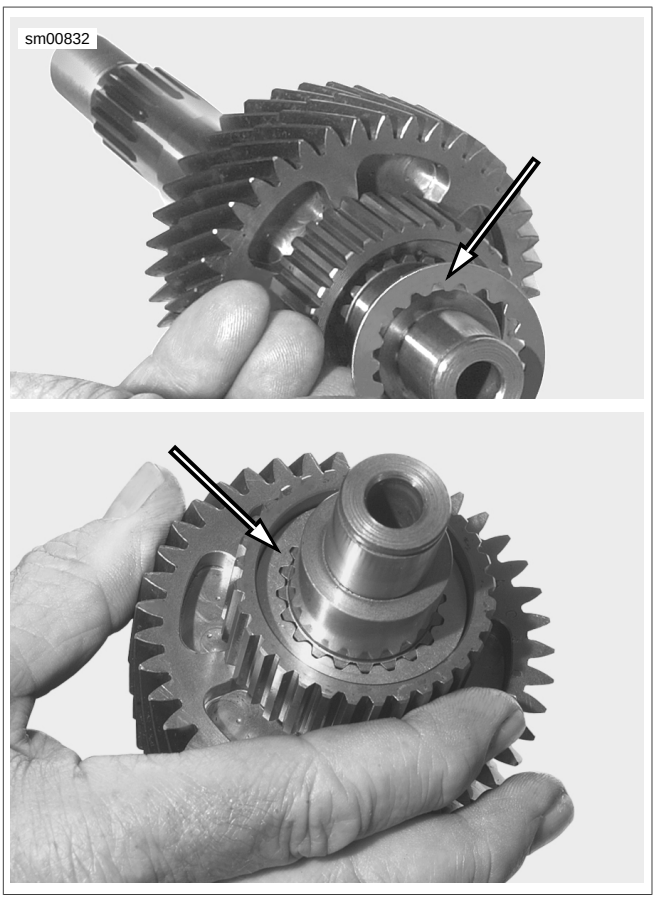



**Figure 7-135. Splined Thrust Washer**

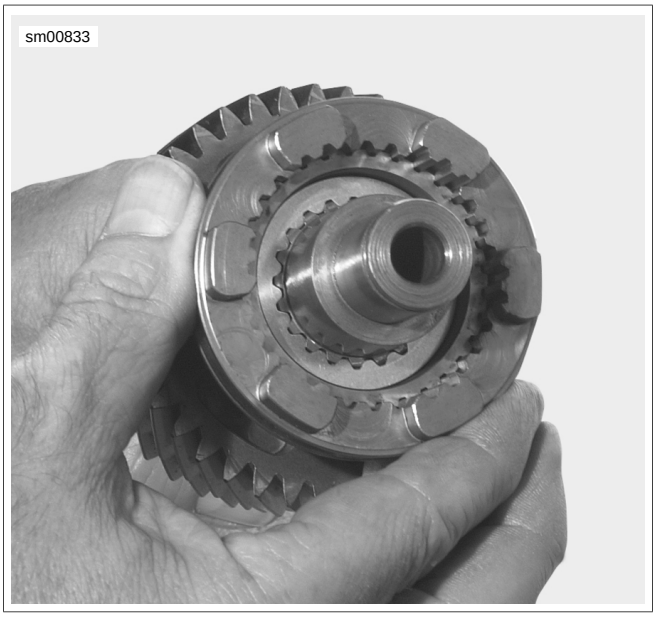



**Figure 7-136. Shift Fork Slider**

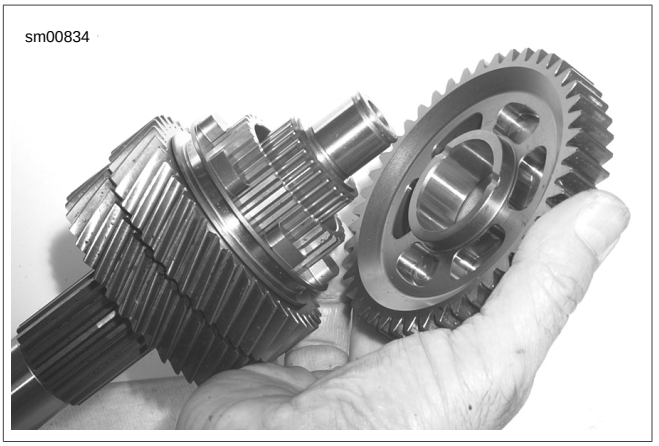



**Figure 7-137. 1st Gear**

## DISASSEMBLY - 2ND GEAR END

| PART NUMBER | TOOL NAME |
|---|---|
| HD-34902-B | BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER |

### Bearing Removal - 2nd Gear End

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**

1. See Figure 7-138. Remove retaining ring at 2nd gear crankcase bearing.

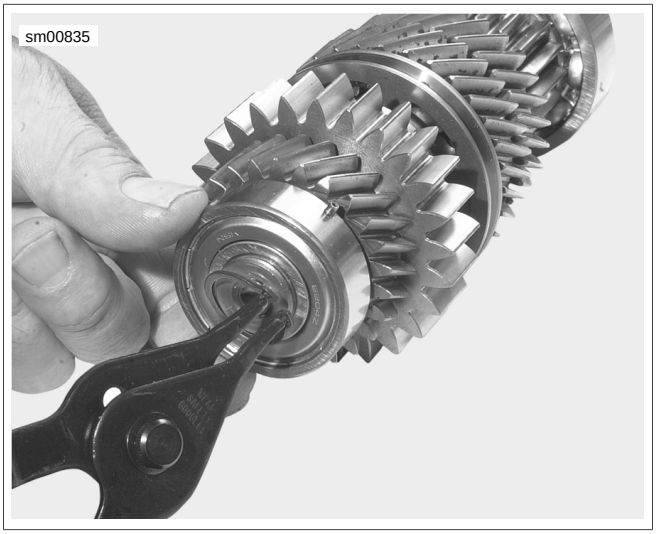



**Figure 7-138. 2nd Gear Bearing Retaining Ring**

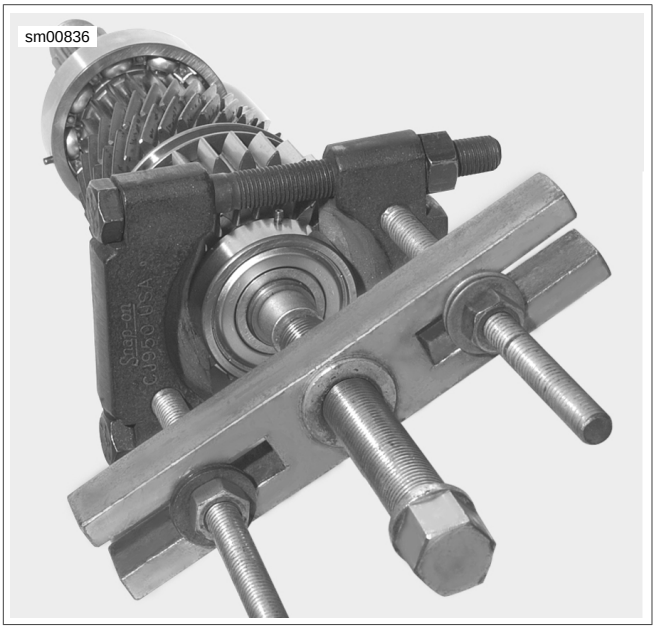



**Figure 7-139. 2nd Gear Bearing Removal**

2. See Figure 7-139. Use puller to remove 2nd gear bearing. To protect the end of the shaft use BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER (Part No. HD-34902-B).

*NOTE*

*If no further disassembly of this end is needed go to step 3. If further disassembly of this end is needed go to step 4.*

### Bearing Installation - 2nd Gear End

1. See Figure 7-140. Install **new** bearing with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

**⚠WARNING**

**Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)**




**Figure 7-140. 2nd Gear Bearing Alignment Pin**

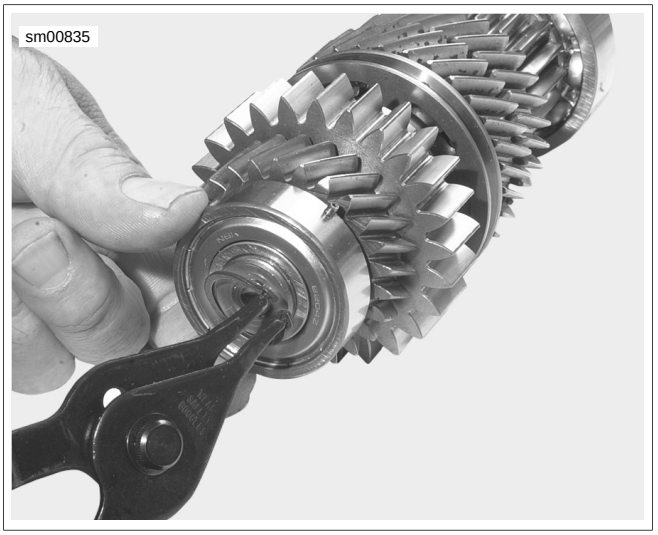



**Figure 7-141. 2nd Gear Bearing Retaining Ring**

2. See Figure 7-141. Install retaining ring.

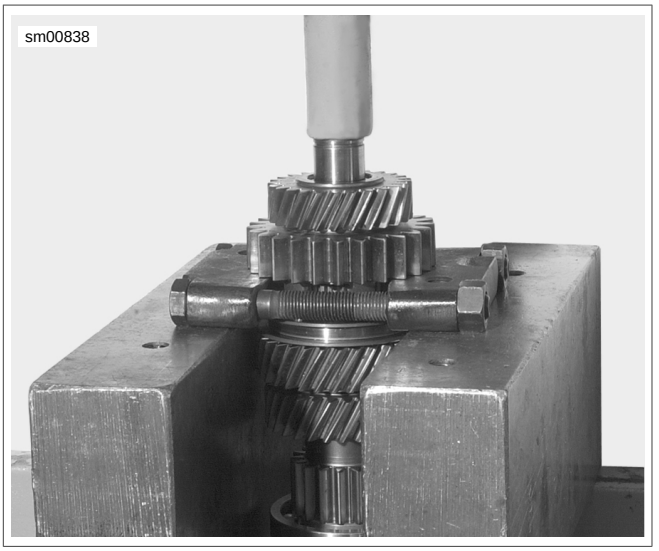



**Figure 7-142. 2nd and 5th Gear Removal**

3. See Figure 7-142. Place a puller clamp behind 5th gear and press off 2nd and 5th gear. Support the input shaft when removing the gears.

*NOTE*

*2nd gear is an interference fit and MUST be replaced when removed from the input shaft regardless of its condition.*

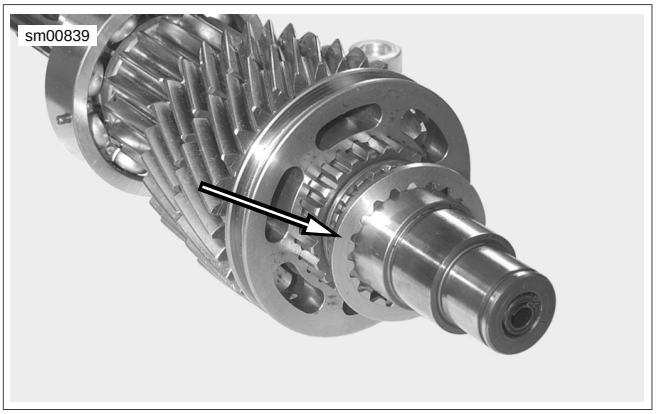



**Figure 7-143. Splined Thrust Washer**

4. See Figure 7-143. Remove the splined thrust washer.

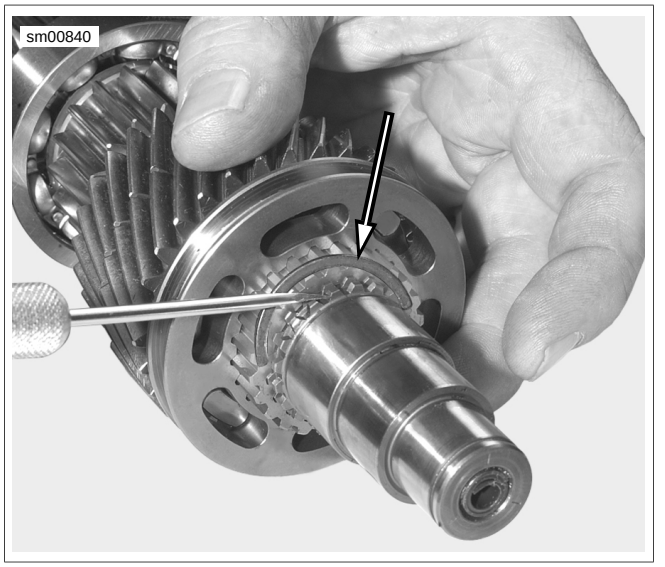



**Figure 7-144. Half Moon Keepers**

5. See Figure 7-144. Remove half moon keepers.

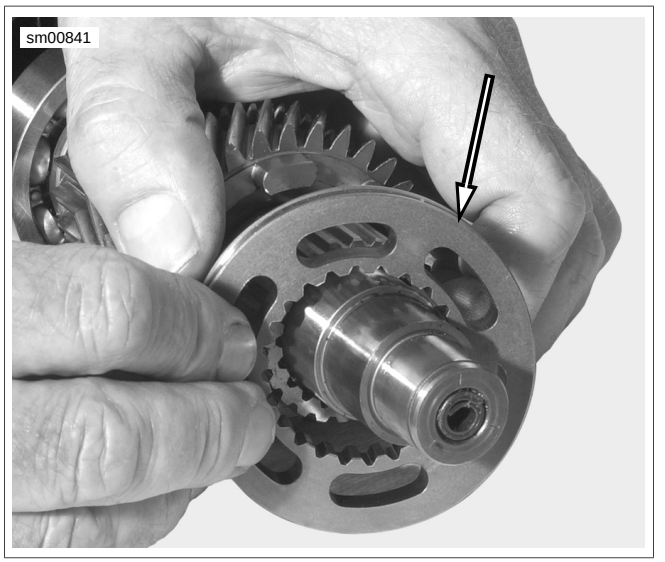



**Figure 7-145. Shifting Fork Ring**

6. See Figure 7-145. Remove shifting fork ring.

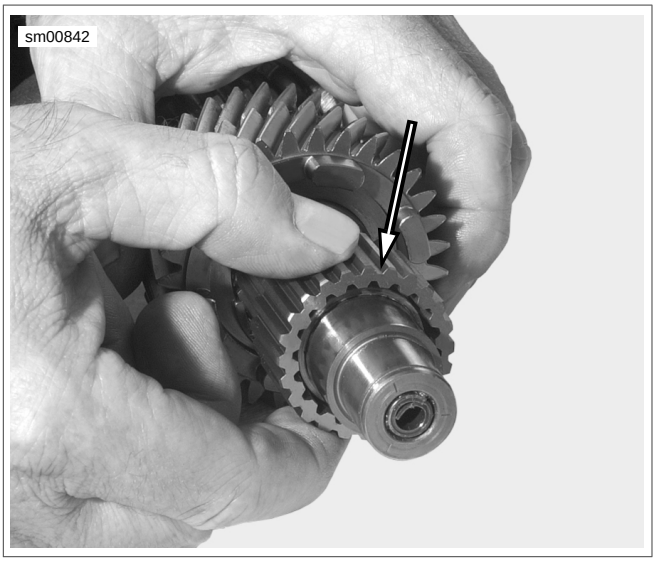



**Figure 7-146. Splined Slider**

7. See Figure 7-146. Remove splined slider.

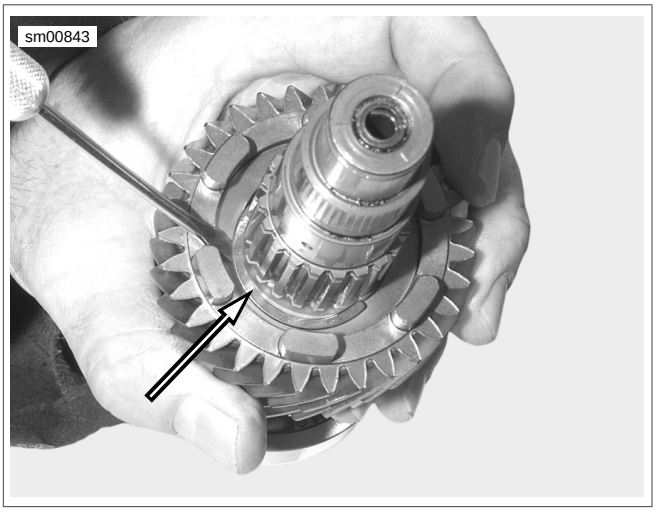



**Figure 7-147. Half Moon Keepers**

8. See Figure 7-147. Remove half moon keepers.

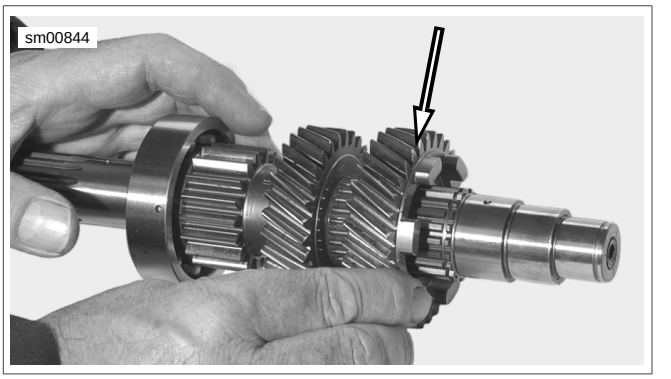



**Figure 7-148. 4th Gear**

9. See Figure 7-148. Remove 4th gear.

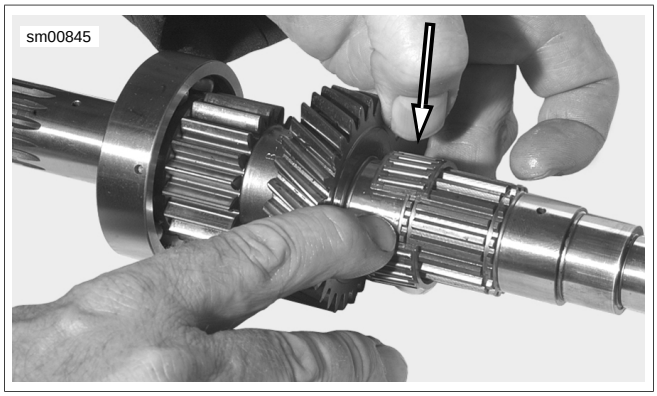



**Figure 7-149. Split Cage Bearing**

10. See Figure 7-149. Remove split cage bearing.

*NOTE*

*See Figure 7-109. 1st gear and 3rd gear are part of the input shaft assembly and are not removable. Damage to 1st or 3rd gear requires replacement of the input shaft.*

## ASSEMBLY - 2ND GEAR END

1. See Figure 7-150. Lubricate **new** split cage bearing and position on shaft. Install 4th gear and place half moon keepers in position.

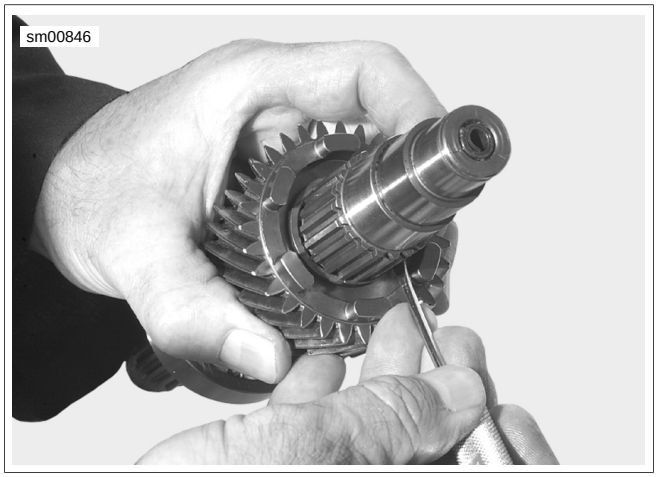



**Figure 7-150. 4th Gear and Keepers**

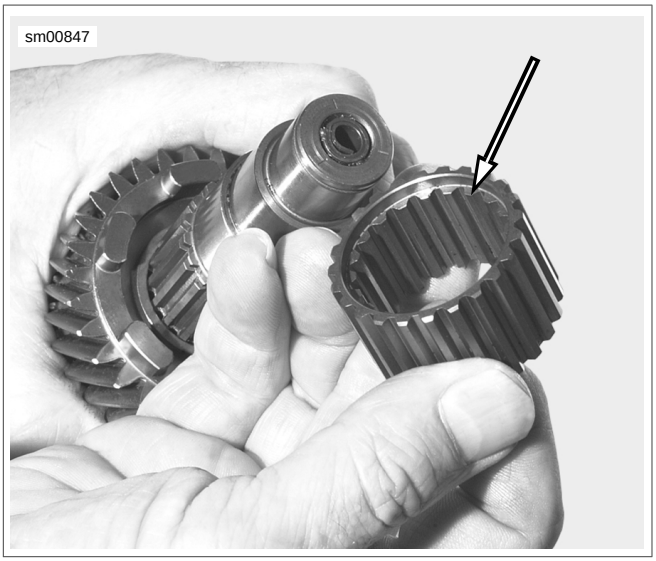



**Figure 7-151. Splined Slider**

2. See Figure 7-151. Insert splined slider with stepped side toward 4th gear.

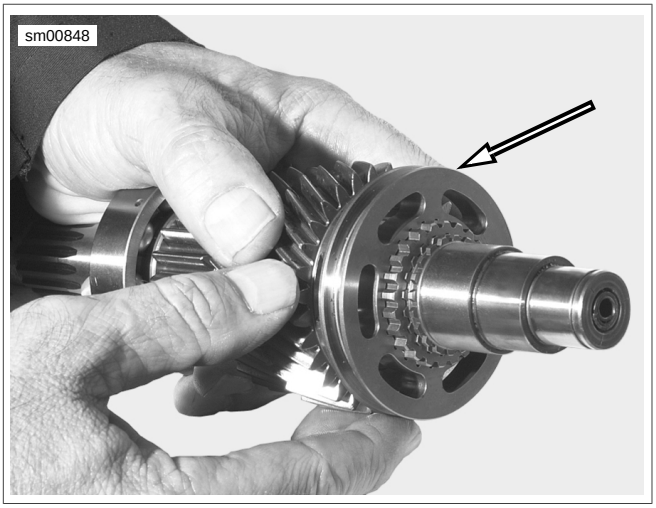



**Figure 7-152. Shift Fork Slider**

3. See Figure 7-152. Install shift fork slider.

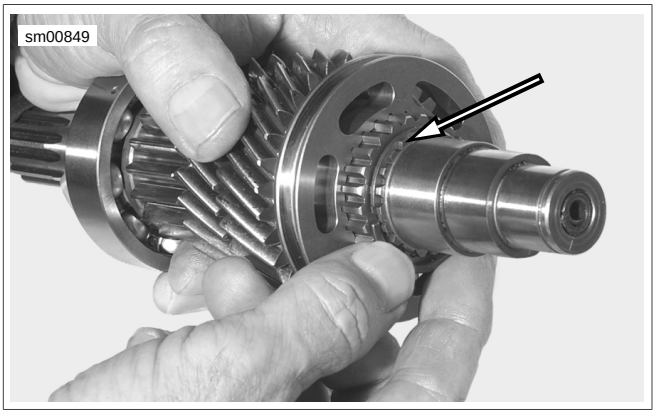



**Figure 7-153. Half Moon Keepers**

4. See Figure 7-153. Install half moon keepers.

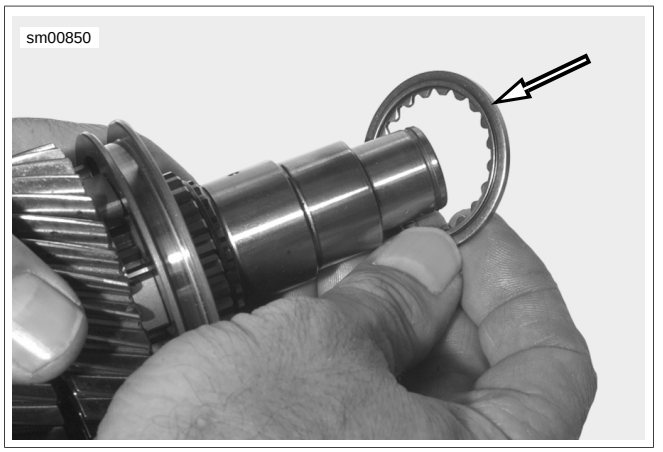



**Figure 7-154. Splined Thrust Washer**

5. See Figure 7-154. Install splined thrust washer, stepped side toward gears.

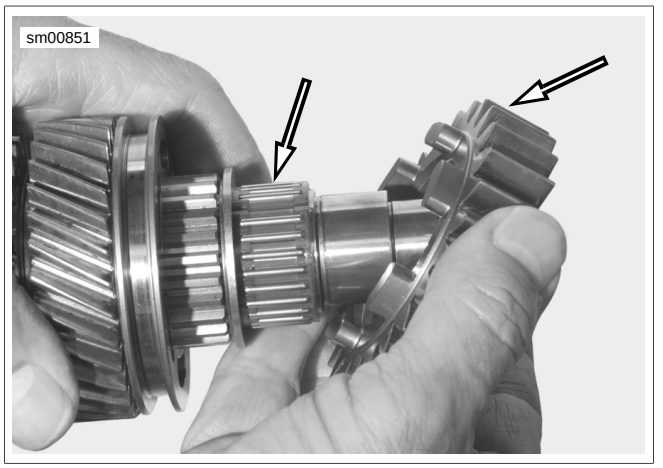



**Figure 7-155. Bearing and 5th Gear**

6. See Figure 7-155. Install lubricated **new** split cage bearing behind splined thrust washer. Install 5th gear over split cage bearing.

*NOTE*

*2nd gear is an interference fit and MUST be replaced when removed from the input shaft, regardless of its condition.*

7. See Figure 7-155. Install **new** 2nd gear. Use a pressing ring to clear the shaft. Press gear on shaft until it bottoms on the gearset.

8. To complete input shaft assembly -2nd gear end go to 7.7 INPUT SHAFT, Disassembly - 2nd Gear End.




**Figure 7-156. 2nd Gear**

## DISASSEMBLY - 1ST GEAR END

### Bearing Removal - 1st Gear End

1. See Figure 7-157. Remove 1st gear crankcase bearing.

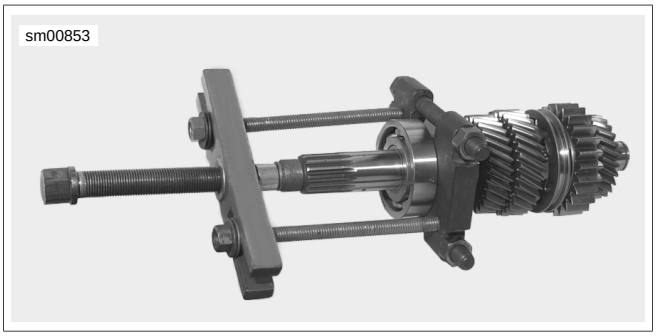



**Figure 7-157. 1st Gear Bearing Removal**

## ASSEMBLY - 1ST GEAR END

### Bearing Installation - 1st Gear End

1. See Figure 7-158. Install **new** bearing, with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.




**Figure 7-158. 1st Gear Bearing Replacement**

# NOTES

**SUBJECT** **PAGE NO.**
8.1 SPECIFICATIONS: ELECTRICAL....8-1
8.2 ELECTRONIC CONTROL MODULE (ECM)....8-2
8.3 RELAY AND FUSE BLOCK....8-3
8.4 MAXI-FUSE....8-5
8.5 VOLTAGE REGULATOR....8-6
8.6 IGNITION/HEADLAMP KEY SWITCH....8-8
8.7 HEADLAMP: VRSCAW....8-9
8.8 HEADLAMP: VRSCD/VRSCDX....8-11
8.9 TAIL LAMP....8-13
8.10 TURN SIGNALS AND RUNNING LIGHTS....8-15
8.11 TURN SIGNAL SECURITY MODULE (TSSM)....8-17
8.12 CRANK POSITION SENSOR (CKP)....8-18
8.13 ALTERNATOR....8-19
8.14 INSTRUMENT CLUSTER: VRSCAW....8-23
8.15 INSTRUMENT CLUSTER: VRSCD/VRSCDX....8-25
8.16 VEHICLE SPEED SENSOR (VSS)....8-26
8.17 NEUTRAL SWITCH....8-27
8.18 OIL PRESSURE SWITCH....8-28
8.19 STOPLIGHT SWITCH: FORWARD MOUNT CONTROLS....8-29
8.20 STOPLIGHT SWITCH: MID-MOUNT CONTROLS....8-30
8.21 HORN....8-31
8.22 COOLING FANS....8-33
8.23 HANDLEBAR SWITCH ASSEMBLIES....8-35
8.24 RIGHT HANDLEBAR SWITCH....8-36
8.25 LEFT HANDLEBAR SWITCH....8-42

# NOTES

## GENERAL

**Table 8-1. Ignition System: 2008 VRSC Models**

| ITEM | SPECIFICATION | |
|---|---|---|
| Timing setting | Not adjustable | |
| Battery | 12 volt, 19 amp/hr, 270 CCA | |
| Spark plug type | 10R12A | |
| Spark plug gap | 0.035 in. | 0.89 mm |
| Spark plug torque | 17 ft-lbs | 23 Nm |

**Table 8-2. Fuse Specifications**

| FUSE | RATING (AMPERES) |
|---|---|
| Maxi-fuse | 40 |
| ABS fuse (if equipped) | 15 |
| Battery fuse (instrument console/fan relay) | 15 |
| Ignition fuse | 15 |
| Lighting fuse | 15 |
| Accessory fuse | 15 |
| ECM fuse | 15 |
| Security fuse | 15 |
| Fuel pump fuse | 15 |

**Table 8-3. Charging System Specifications**

| CHARGING SYSTEM | DATA |
|---|---|
| Battery | 19 amp hour/270 CCA |
| Alternator AC voltage output, open circuit (at stator connector) | 19 VAC ± 10% per 1000 rpm 22.5 VAC ± 10% @ idle (1200 rpm) |
| Alternator stator coil resistance | 0.1 - 0.3 ohms |
| Regulator voltage output (with fully charged battery) | 14.5 ± 0.25 volts @ 1200 rpm 20° C ± 5 ° C (68° F± 9° F) |
| Regulator current | 22A min. @ 1200 RPM 36A min. @ 3500 RPM |

## GENERAL

The electronic control module (ECM) is mounted under the passenger pillion. Refer to the VRSC ELECTRICAL DIAGNOSTIC MANUAL for information on the function and testing of the electronic control module.

*NOTE*

*The electronic control module cannot be repaired. Replace the unit if it fails.*

## REMOVAL

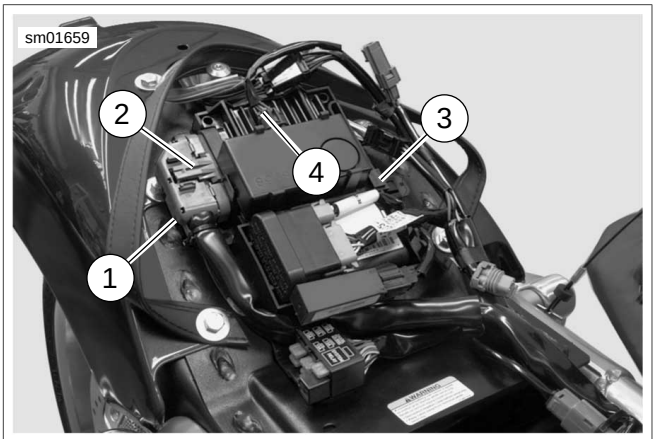
**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Disable alarm system (if equipped).
2. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat and remove passenger pillion.
4. See Figure 8-1. Lift upward on electrical caddy and depress latch (2) on ECM connector (1) [78B] and disconnect from ECM.
5. Push downward on ECM and remove ECM (1) from bottom of electrical caddy.

## INSTALLATION

1. See Figure 8-1. Install ECM (4) into bottom of electrical caddy (3) and press firmly until ECM is fully seated.
2. Install electrical caddy to rear fender, locking all tabs into place.
3. Insert ECM connector (1) [78B] into ECM latch locks.
4. Install maxi-fuse.
5. Install right side covers.
6. Install passenger pillion and close seat.




1. **ECM connector [78B]**
2. **Latch**
3. **Electrical caddy**
4. **ECM (Electronic Control Module)**

**Figure 8-1. ECM**

## GENERAL

The relay/fuse block assembly consists of two relay/fuse blocks and is located under the right side cover and the rear seat. All relays and fuses (with the exception of the main battery fuse - see 8.4 MAXI-FUSE) are contained in these two relay/fuse blocks.

*NOTE*

*If motorcycle is ABS equipped, the fuse will be located between the SPARE and IGNITION fuses in the fuse block that is located behind the right side cover.*

## RELAY/FUSE BLOCK REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Open seat.
3. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
4. See Figure 8-2. Gently lift up each relay/fuse block cover release tab (2) and slide each relay/fuse block assembly out of the cover.

## FUSE REPLACEMENT

1. See Figure 8-4. Grasp the suspect fuse and gently pull straight out of the fuse socket.
2. Inspect the fuse element. Replace the fuse if the element is burned or broken.
3. Line up the pins of the fuse with the socket holes in the relay/fuse block. Push gently down on the fuse body until it bottoms out in the socket.

*NOTES*

- *Two spare fuses are located in the left relay/fuse block.*
- *If ABS equipped, ABS fuse will be located between spare and ignition fuses in front fuse block.*

**CAUTION**

**Always use replacement fuses that are of the correct type and amperage rating. Use of incorrect fuses can result in damage to electrical systems. (00222a)**

*NOTE*

*Use only automotive type ATO fuses as replacements.*

## RELAY REPLACEMENT

1. See Figure 8-4. If a relay is diagnosed as defective, grasp the body of the relay and with a gentle rocking motion, pull straight out of the socket.
2. Line up the pins of the **new** relay with the socket holes in the relay/fuse block. Push gently down on the relay body until it bottoms out in the socket.

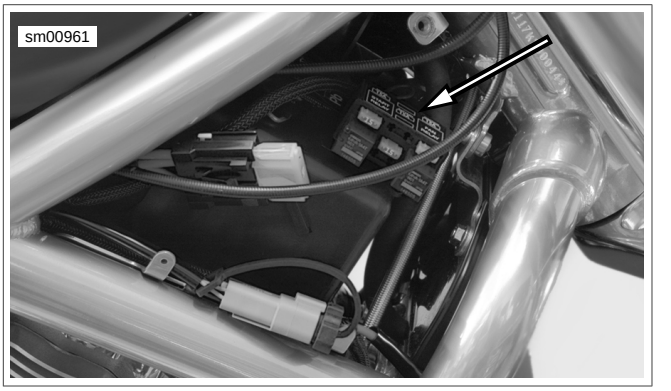



**Figure 8-2. Front Relay/Fuses**

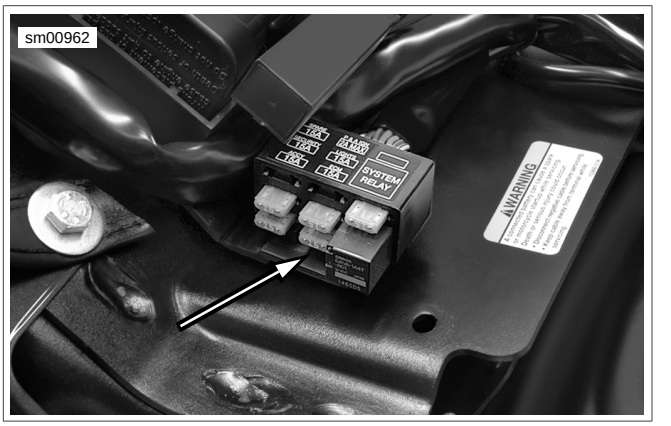



**Figure 8-3. Rear Relay/Fuses**

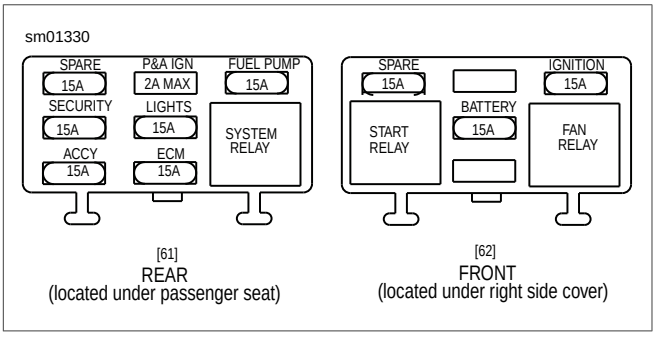



**Figure 8-4. Relay/Fuse Blocks (NON-ABS shown)**

## RELAY/FUSE BLOCK INSTALLATION

1. See Figure 8-2. Slide each relay/fuse block assembly back into relay/fuse block cover. Push relay/fuse block assembly into the cover until cover release tab locks into place.
2. Replace airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
3. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.
4. Replace maxi-fuse and right side cover.

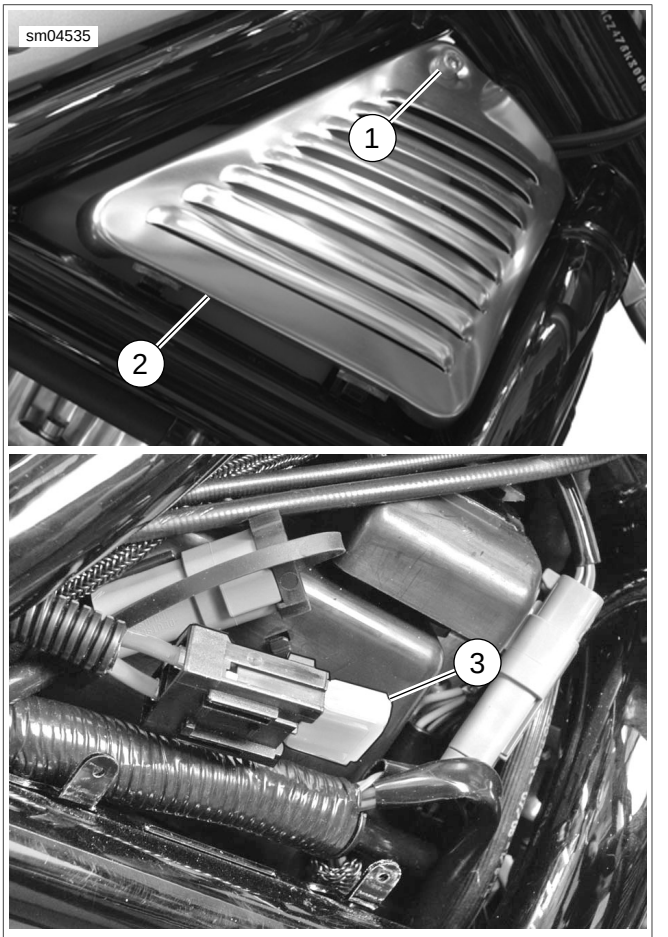
5. Test the vehicle system that is controlled by the relay or fuse that was replaced.

## GENERAL

There is a main battery fuse to protect the motorcycle wiring. This 40-amp maxi-fuse provides main battery power to the motorcycle. It is located in a rubber-coated fuse holder behind the motorcycle's right front side cover.

## REPLACEMENT

1. See Figure 8-5. Remove the fastener (1) securing the side cover (2). Carefully lift the side cover off the mounting tabs and set it aside.
2. Grasp the fuse holder in one hand, the plastic body of the maxi-fuse (3) in the other, and pull the maxi-fuse straight out of the fuse holder.
3. Insert the prongs of the **new** maxi-fuse in the fuse holder slots. Push the maxi-fuse firmly down into the fuse holder.
4. Replace the side cover and install the fastener. Tighten to 4.1-6.8 Nm (36-60 **in-lbs**).




1. **Fastener**
2. **Side cover**
3. **Maxi-Fuse (40 amp)**

**Figure 8-5. Maxi-Fuse**

## GENERAL

The voltage regulator is mounted on the lower front radiator cover.

*NOTE*

*The voltage regulator cannot be repaired. Replace the unit if it fails.*

## REMOVAL

1. Remove right side cover and Maxi-Fuse. See 8.4 MAXI-FUSE.

**⚠ WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

2. Remove left and right radiator trim covers. See 1.6 RADIATOR SIDE COVERS.
3. Cover front fender with shop towel or protective cover. Remove fasteners and washers on each side of radiator cover. Remove radiator cover with chrome inlet bezels attached.

*NOTE*

*Before removing voltage regulator wires, carefully note wire routing. In particular, pay close attention to locations of cable straps that must be replaced.*

4. See Figure 8-6. Release locks on wiring connectors and remove connectors from back of regulator.

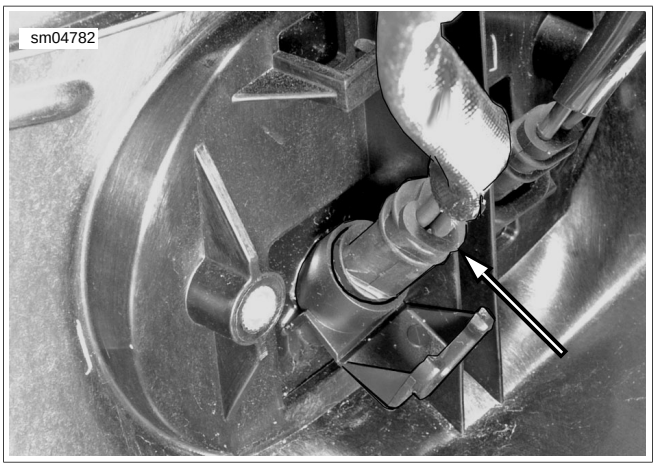



**Figure 8-6. Voltage Regulator Connector**

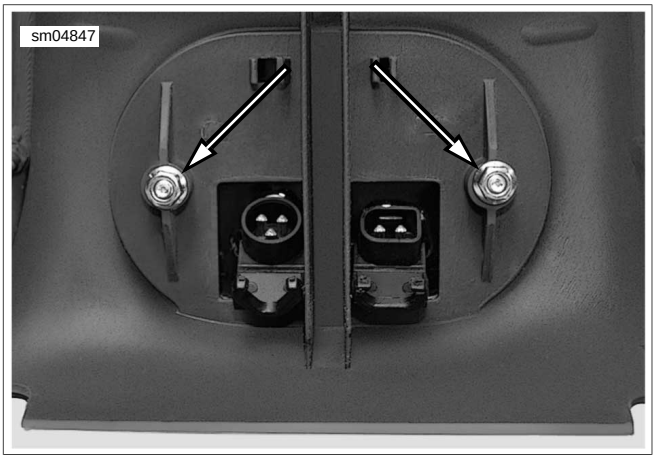



**Figure 8-7. Voltage Regulator Internal Mounting Points**

5. See Figure 8-7. Remove fasteners from regulator mounting points and remove regulator from front cover.

## INSTALLATION

1. See Figure 8-8 Attach **new** voltage regulator to front cover with two mounting fasteners. Tighten to 6-10 Nm (53-88 **in-lbs**).
2. See Figure 8-9 Insert both voltage regulator connections and lock into place with lock tabs.
3. Install any cable straps or wires ties that may have been removed.
4. Install radiator front cover and front cover fasteners.
5. Attach radiator side covers. See 1.6 RADIATOR SIDE COVERS.
6. See Figure 8-10. Press rear brake master cylinder reservoir back into its mounting slots in right side of radiator cover.
7. Replace maxi-fuse. See 8.4 MAXI-FUSE.
8. See the VRSC ELECTRICAL DIAGNOSTIC MANUAL and check voltage regulator for proper output.

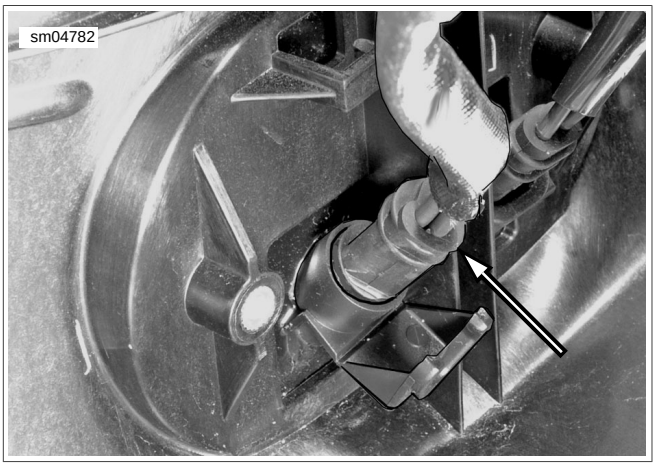



**Figure 8-8. Voltage Regulator Connector**

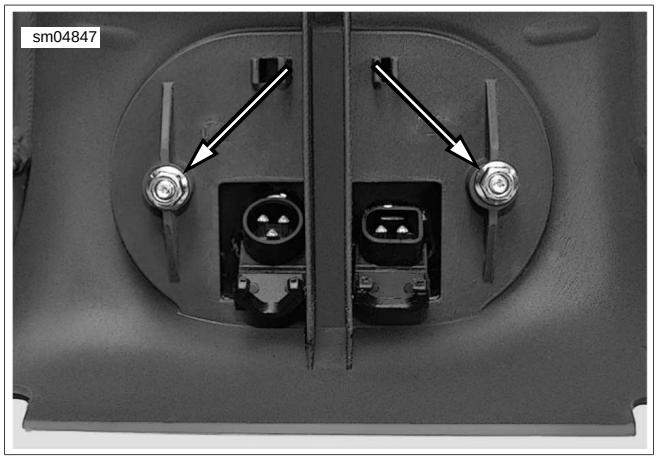



**Figure 8-9. Voltage Regulator Internal Mounting Points**

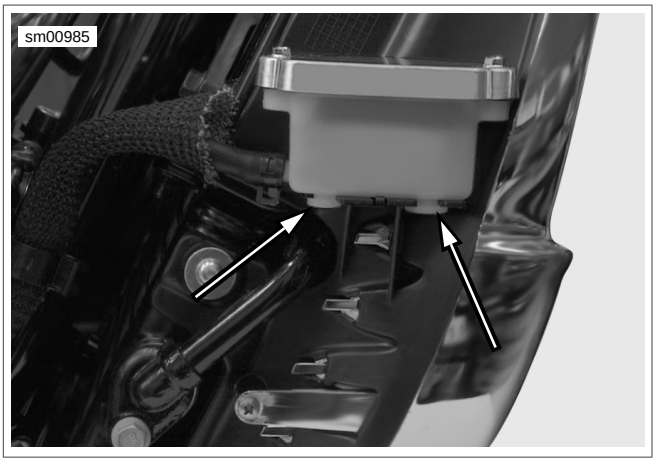



**Figure 8-10. Rear Brake Master Cylinder Reservoir Mounting Slots**

## GENERAL

The ignition switch is non-repairable. If damaged, it must be replaced. The replacement ignition switch includes a fork lock, plunger and keys. The ignition switch and fork lock should be replaced at the same time so one key is used for both ignition and fork lock.

**⚠WARNING**

**The automatic-on headlamp feature provides increased visibility of the rider to other motorists. Be sure headlamp is on at all times. Poor visibility of rider to other motorists can result in death or serious injury. (00030b)**

## REPLACEMENT

1. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. See Figure 8-11. Remove ignition switch protective cover by pressing in location shown by arrows using thumb and index fingers. Simultaneously lift up at bottom of protective switch cover with index finger of opposite hand and pull cover away from base of switch.




**Figure 8-11. Ignition Switch Cover**

3. See Figure 8-12. Remove fasteners and remove ignition switch from frame.

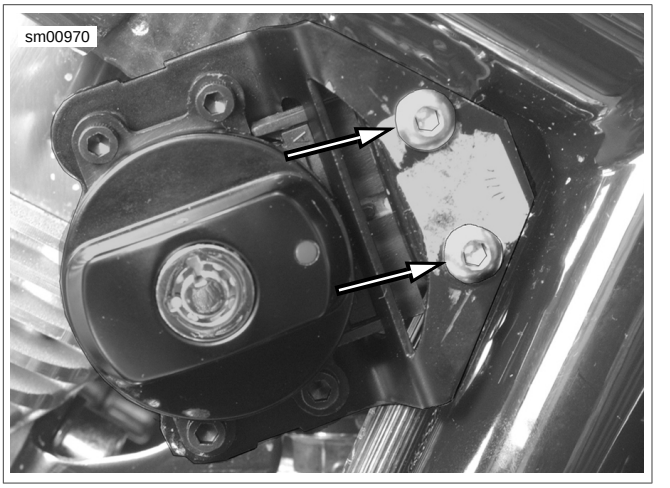



**Figure 8-12. Ignition Switch Fasteners**

4. See Figure 8-13. Carefully release latching tabs securing wiring harness connector to back of ignition switch. Pull connector out of ignition/light switch socket.

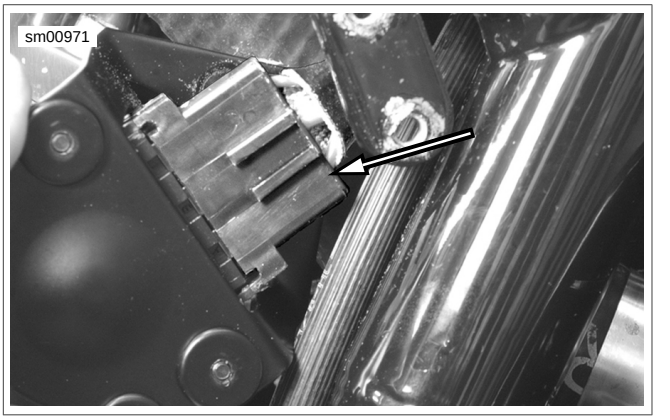



**Figure 8-13. Ignition Switch Connector (switch turned over showing back side)**

5. Insert wiring harness connector into **new** ignition switch. Gently push connector into socket until it locks into place.
6. See Figure 8-12. Install ignition switch to frame. Secure with fasteners. Tighten fasteners to 4-7 Nm (35-62 **in-lbs**).
7. Replace right side cover and maxi-fuse.
8. Test all functions of ignition switch.

## GENERAL

The headlamp contains separate high and low-beam headlamp bulbs. Each bulb is a replaceable high output quartz halogen bulb type.

**CAUTION**

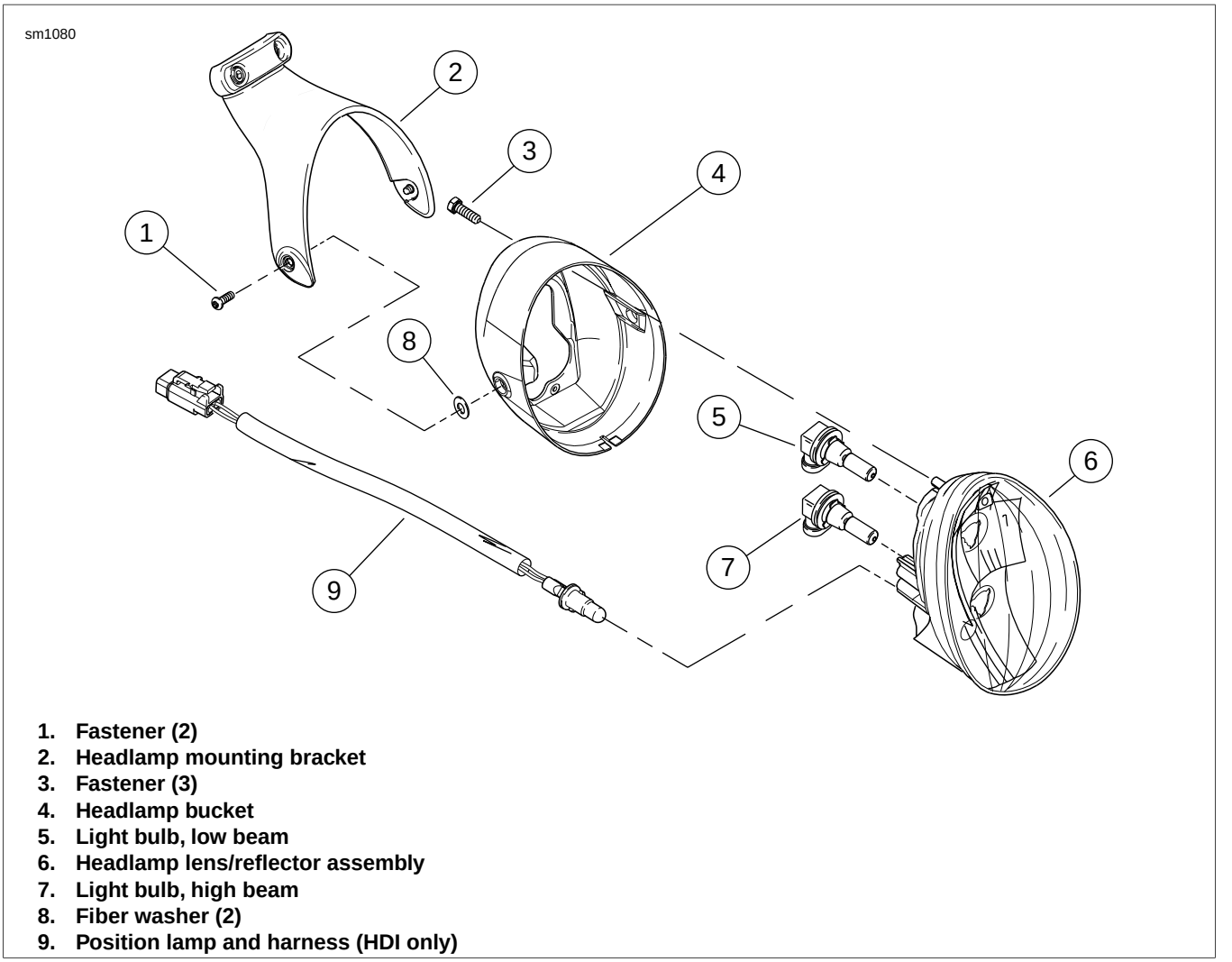
**When replacement is required, use only the specified sealed beam unit or bulb, available from a Harley-Davidson dealer. An improper wattage sealed beam or bulb, can cause charging system problems. (00209a)**

**CAUTION**

**Never touch the quartz bulb. Fingerprints will etch the glass and decrease bulb life. Grab the bulb with paper or a clean, dry cloth. Failure to do so could result in bulb damage. (00210a)**

**WARNING**

**Handle bulb carefully and wear eye protection. Bulb contains gas under pressure, which, if not handled carefully, could cause serious eye injury. (00062b)**




1. **Fastener (2)**
2. **Headlamp mounting bracket**
3. **Fastener (3)**
4. **Headlamp bucket**
5. **Light bulb, low beam**
6. **Headlamp lens/reflector assembly**
7. **Light bulb, high beam**
8. **Fiber washer (2)**
9. **Position lamp and harness (HDI only)**

**Figure 8-14. Headlamp**

## HEADLAMP BULB

### Removal

*NOTE*

*It is not necessary to disassemble the headlamp assembly in order to replace headlamp bulbs.*

1. See Figure 8-14. To replace the low beam or high beam headlamp bulb, reach behind the headlamp bucket and grasp the appropriate headlamp bulb socket connector.
2. Squeeze the release latches on the connector and pull the connector away from the headlamp bulb.
3. While facing the headlamp from behind (looking toward the front of the motorcycle), twist the headlamp bulb

approximately 45 degrees counterclockwise (CCW) and gently pull straight out of the headlamp.

## Installation

*NOTE*

*The low beam headlamp bulb (labeled H11) mounts in the top hole in the rear of the headlamp assembly. The high beam bulb (labeled H9) mounts in the bottom hole.*

1. See Figure 8-14. To install a **new** headlamp bulb, insert it into the hole in the rear of the headlamp. Facing the headlamp assembly from the rear (looking toward the front of the motorcycle):
   a. Position the low beam bulb with its connector housing pointing to approximately 4 o'clock.
   b. Position the high beam bulb with it's connector housing pointing to approximately 5 o'clock.
2. Gently twist the bulb clockwise (CW) approximately 45 degrees, until it stops.

*NOTE*

*Do NOT force the connector onto the headlamp bulb socket. The two headlamp connectors are not interchangeable. Forcing the wrong connector onto the bulb will damage the connector pins and/or bulb socket.*

**⚠WARNING**

**Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)**

3. Gently push the headlamp wiring connector onto the headlamp bulb socket until it clicks into place.

## GENERAL

The headlamp contains separate high and low-beam headlamp bulbs. Each bulb is a replaceable high output quartz halogen bulb type.

**CAUTION**

**When replacement is required, use only the specified sealed beam unit or bulb, available from a Harley-Davidson dealer. An improper wattage sealed beam or bulb, can cause charging system problems. (00209a)**

**CAUTION**

**Never touch the quartz bulb. Fingerprints will etch the glass and decrease bulb life. Grab the bulb with paper or a clean, dry cloth. Failure to do so could result in bulb damage. (00210a)**

**WARNING**

**Handle bulb carefully and wear eye protection. Bulb contains gas under pressure, which, if not handled carefully, could cause serious eye injury. (00062b)**

## HEADLAMP BULB

### Removal

*NOTE*

*It is necessary to partially disassemble the headlamp in order to replace headlamp bulbs. Note the positions of the mounting screws in the headlamp bucket retainer for reassembly.*

1. See Figure 8-15. Loosen M10 fastener (10) and allow headlamp/nacelle assembly to drop slightly forward.
2. Remove fasteners (3), washers (4) and remove headlamp bucket retainer (5) from nacelle (23).
3. Reach behind the headlamp bucket (6) and grasp the headlamp connector (8).
4. Squeeze the release latches on the connector and pull the connector away from the headlamp bulb.
5. While facing the headlamp from behind (looking toward the front of the motorcycle), twist the headlamp bulb approximately 45 degrees counterclockwise (CCW) and gently pull straight out of the headlamp.

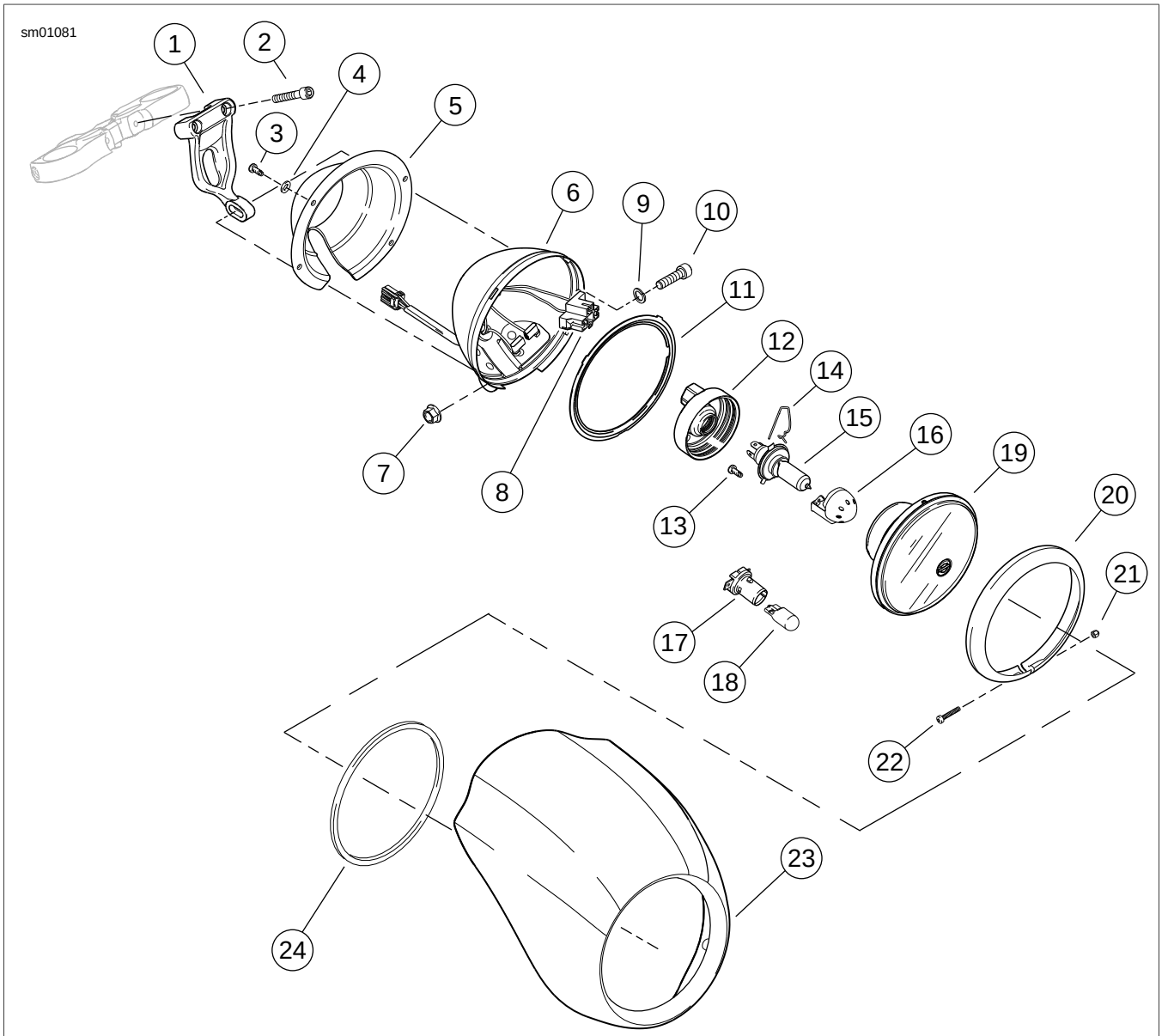
### Installation

1. See Figure 8-15. To install a **new** headlamp bulb, insert it into the hole in the rear of the headlamp. Facing the headlamp assembly from the rear (looking toward the front of the motorcycle):
2. Position the headlamp bulb with its connector housing pointing to approximately 4 o'clock.
3. Gently twist the bulb clockwise (CW) approximately 45 degrees, until it stops.

*NOTE*

*Do NOT force the connector onto the headlamp bulb socket. The two headlamp connectors are not interchangeable. Forcing the wrong connector onto the bulb will damage the connector pins and/or bulb socket.*

4. Gently push the headlamp wiring connector onto the headlamp bulb socket until it clicks into place.
5. Install headlamp bucket retainer (5) with washers (4) and fasteners (3). Tighten fasteners to 3.4-5.6 Nm (30-50 **in-lbs**).
6. Move headlamp/nacelle assembly into place and snug fastener (10) and perform headlamp alignment. See 1.27 HEADLAMP ALIGNMENT.




1. **Headlamp mounting bracket**
2. **Screw**
3. **Fastener (2)**
4. **Washer (4)**
5. **Headlamp bucket retainer**
6. **Headlamp bucket**
7. **Nut, hex flange, M10**
8. **Headlamp connector**
9. **Washer, M10**
10. **Fastener, M10**
11. **Lamp adapter ring**
12. **Boot**
13. **Screw**
14. **Clip**
15. **Bulb**
16. **Bulb shield**
17. **Bulb socket**
18. **Bulb**
19. **Headlamp envelope**
20. **Bezel**
21. **Nut**
22. **Screw**
23. **Nacelle**
24. **Seal**

**Figure 8-15. Headlamp (with nacelle)**

## REMOVAL

1. See Figure 8-16. Insert a small screwdriver into middle hole of license plate light cover. Push forward with screwdriver to release tail lamp housing retaining clip.
2. Lift rear of tail lamp housing up and slide housing assembly away from fender.
3. See Figure 8-17. To replace tail lamp bulb:
   a. Turn bulb socket assembly clockwise (CW) and pull outward from tail lamp housing.
   b. Remove bulb by turning counterclockwise (CCW) and pulling from bulb socket assembly.
   c. Push **new** bulb into bulb socket assembly and turn clockwise.
   d. Insert bulb socket assembly into tail lamp housing and turn counterclockwise to lock in place.
4. To replace license plate bulb:
   a. Remove license plate bulb by turning housing counterclockwise. Tab on bulb housing must clear tab on license plate light housing.
   b. Pull bulb from socket and replace with **new** bulb.
   c. Install housing by aligning tabs and turning clockwise.
5. To replace entire tail lamp assembly:
   a. Press down on release latch on connector socket.
   b. Detach socket from wiring harness connector.

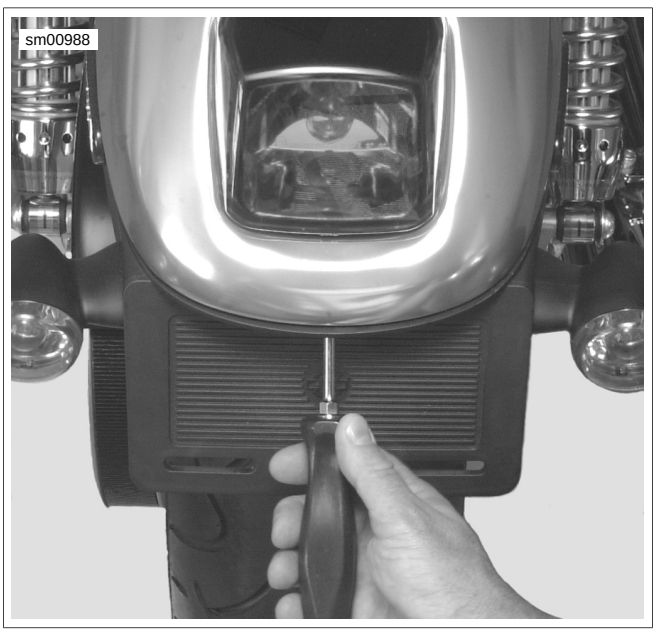
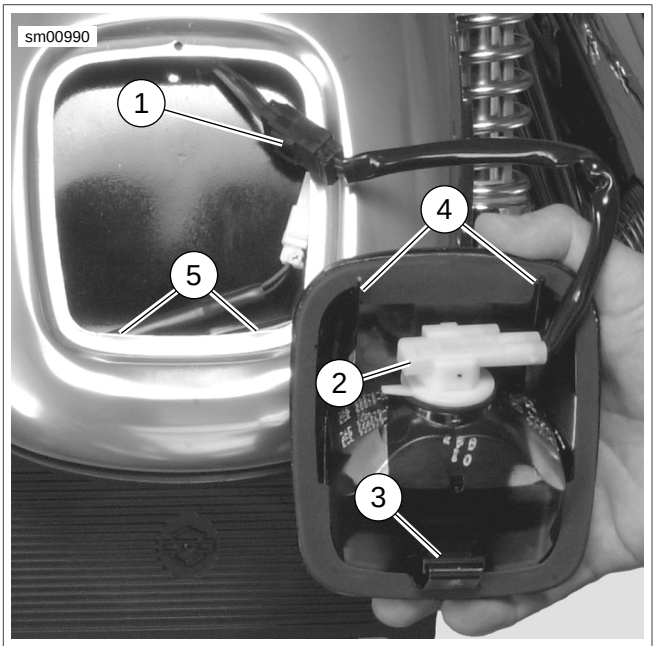



**Figure 8-16. Releasing Tail Lamp Retaining Clip (typical)**




1. **Tail lamp connector**
2. **Tail lamp bulb socket assembly**
3. **Retaining clip**
4. **Mounting tabs**
5. **License plate bulb (2)**

**Figure 8-17. Tail Lamp Wiring (typical)**

## INSTALLATION

1. See Figure 8-17. Route all electrical connectors and wiring harnesses to either side of tail lamp opening in fender, away from tail lamp bulb housing.
2. If entire tail lamp assembly was replaced, insert wiring harness connector in socket and push together gently until release latch locks in place.

*NOTE*

*When installing tail lamp assembly, make sure tail lamp bulb is pointing toward rear of vehicle.*

3. Install tail lamp assembly as follows:
   a. Insert tabs on front of tail lamp housing under forward edge of fender opening.
   b. **Carefully** push tail lamp assembly toward front of vehicle.
   c. Engage retaining clip with rear edge of fender opening. Gently press down on tail lamp assembly until clip locks in place.

*NOTE*

*Retaining clip must engage rear fender opening for tail lamp to remain locked into position in rear fender.*

**⚠WARNING**

**Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)**

4. Turn ignition ON and test for proper tail lamp and brake lamp operation.

## BULB REPLACEMENT

1. Locate notch on edge of front or rear turn signal lens cap.
2. Insert coin in notch. Carefully twist coin until lens pops out of turn signal housing.
3. Replace bulb.
   a. Push bulb in and turn counterclockwise.
   b. Pull bulb from socket when tab on bulb clears opening on socket.
   c. Push **new** light bulb in and turn clockwise to lock in place.
4. Snap lens back into turn signal housing with the notch facing down.

*NOTE*

*If after replacing a bulb, the turn signal or running lamp will not light, check the wiring, the ground at the socket and/or the switch.*

## LAMP REPLACEMENT

### General

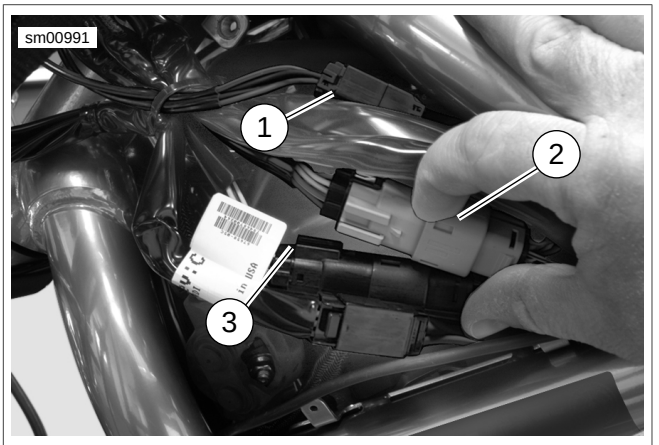
1. Remove right side cover and remove maxi-fuse. See 8.4 MAXI-FUSE.
2. Change turn signal.
3. Replace right side cover and replace maxi-fuse.

### Front Turn Signals

*NOTE*

*Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable wraps which must be replaced if removed.*

1. Remove left side cover.
2. See Figure 8-18. Separate front turn signal connector [31B] from socket [31A].
3. Note locations of turn signal wires in connector. Remove corresponding turn signal wire terminals from connector. See the ELECTRICAL DIAGNOSTIC MANUAL for more information.
4. Wrap wire lead around end of turn signal wire and pull through routing hole in upper fork clamp. Leave wire lead in routing hole.
5. See Figure 8-20. Hold retainer and loosen ball stud clamp to remove turn signal.
6. Pull turn signal wire through the handlebar cable clips around handlebar controls wire sheath.




1. **Front Turn Signal Connector [31]**
2. **Right handlebar controls connector [22]**
3. **Left handlebar controls connector [24]**

**Figure 8-18. Front Turn Signal and Handlebar Control Switch Connectors (typical)**




**Figure 8-19. Front Turn Signal Connector [31] (typical)**

7. Lay old turn signal assembly next to **new** one and cut **new** wires to length. Trim sheath back approximately 63.5 mm (2.5 in) from ends of wires. See the VRSC ELECTRICAL DIAGNOSTIC MANUAL for more information.

8. Install **new** turn signal lamp housing and route wire harness through handlebar cable clips.
9. Wrap wire lead around turn signal wires and pull through routing hole in fork clamp.
10. Crimp **new** pin terminals onto wires.
11. Insert terminals into turn signal connector and mate connector [31B] to socket [31A].
12. Install left side cover.

## Rear Turn Signals

*NOTE*

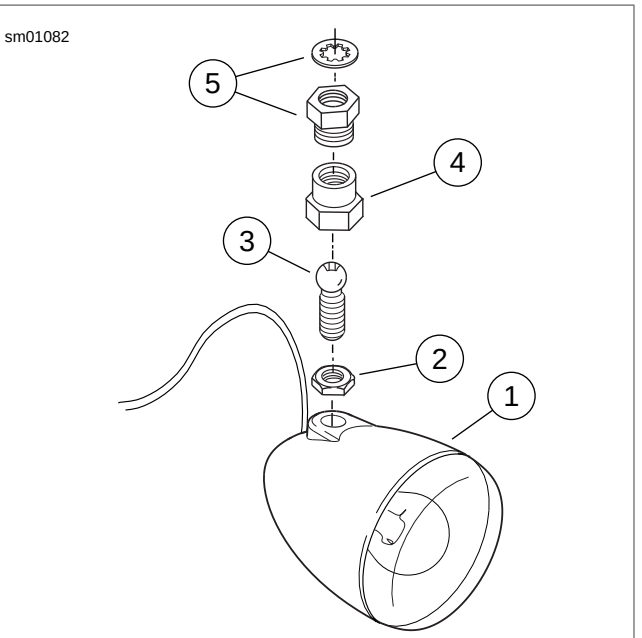
*Before removing turn signal wires, carefully note routing and location of each wire terminal in connector.*

1. See 8.9 TAIL LAMP. Remove tail lamp housing assembly from rear fender. Locate appropriate rear turn signal harness and connector inside tail lamp housing recess in rear fender.
2. See Figure 8-21. Drawing shows rear lighting module assembly removed from rear fender for clarity. Note locations of turn signal wires in connector. Remove turn signal wire terminals from connector. See the VRSC ELECTRICAL DIAGNOSTIC MANUAL for more information.
3. Remove fasteners and support plate. Remove turn signal housing from vehicle. Carefully pull turn signal wiring harness through holes in fender.
4. Install **new** turn signal housing and support plate, routing wiring harness back through holes in fender. Bring wire ends into tail lamp housing recess in rear fender.
5. Insert terminals into turn signal connector and mate connector to socket.

*NOTE*

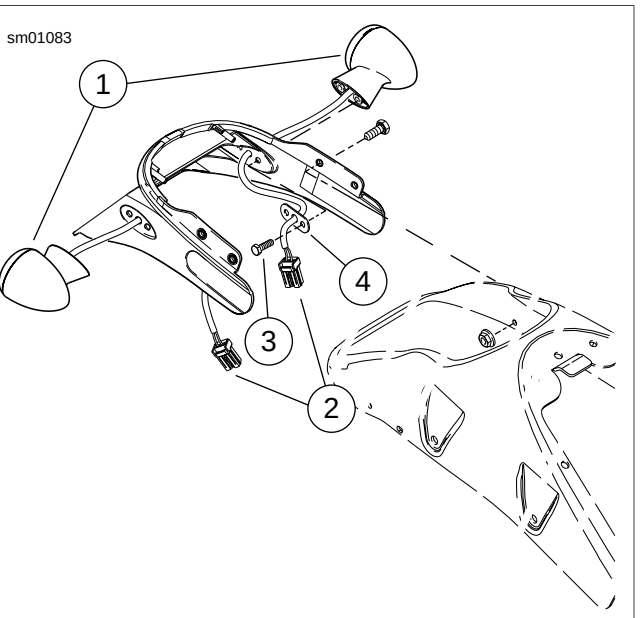
*Be sure to install turn signals on correct sides of motorcycle so pin-sized drain hole is on the bottom to allow proper draining of any water from condensation that may accumulate.*

6. See 8.9 TAIL LAMP and install tail lamp housing assembly into rear fender.




1. **Turn signal**
2. **Jam nut**
3. **Ball stud**
4. **Ball stud clamp**
5. **Retainer and washer**

**Figure 8-20. Front Turn Signal Mounting**




1. **Turn signal assembly (2)**
2. **Turn signal connector (2)**
3. **Fastener (4)**
4. **Support plate (2)**

**Figure 8-21. Rear Turn Signal Mounting (typical)**

**⚠WARNING**

**Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)**

## GENERAL

The Turn Signal Security Module (TSSM) is located beneath the passenger seat, mounted in an electrical caddy on the rear fender.

## REMOVAL

1. Verify security lamp is not blinking (vehicle is disarmed).
2. Remove maxi-fuse. See 8.4 MAXI-FUSE.
3. Open seat.
4. See Figure 8-22. Remove fastener and washer. Slide passenger seat forward slightly to detach it from the mounting tab on the rear of the fender. Then slide seat back and out from underneath seat strap. Remove passenger seat from motorcycle.
5. See Figure 8-23. Squeeze wiring harness connector release latches and carefully pull wiring harness connector out of connector socket on TSSM.
6. Lift up TSSM and slide it out of mounting bracket.

## INSTALLATION

1. Slide **new** TSSM into mounting bracket. Make sure TSSM slides all the way forward in the bracket.
2. Carefully insert wiring harness connector into TSSM socket. Push connector all the way in until release latches lock in place.

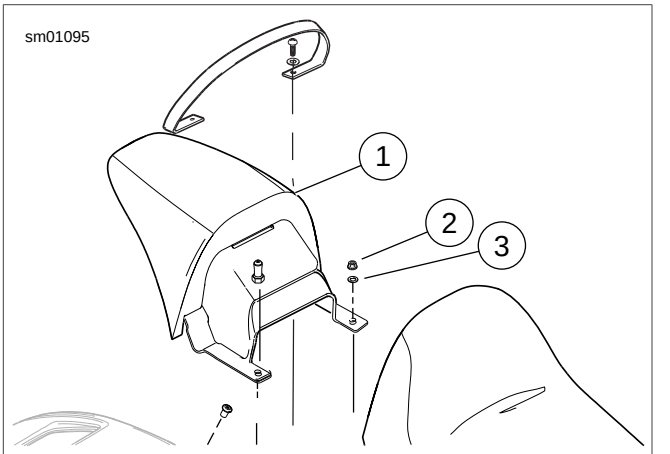
*NOTE*

*The wiring harness connector is keyed and can only be inserted fully in the TSSM socket one way. DO NOT force the connector into the socket. Doing so can damage the connector and/or socket.*

3. See Figure 8-22. Slide passenger seat under seat strap and engage mounting tab on the fender into slot in bottom rear of seat. Make sure TSSM wiring harness is not pinched under seat frame.
4. Attach passenger seat to motorcycle with fastener and washer. Tighten to 11-17 Nm (97-150 **in-lbs**).
5. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.
6. Replace maxi-fuse and right side cover.

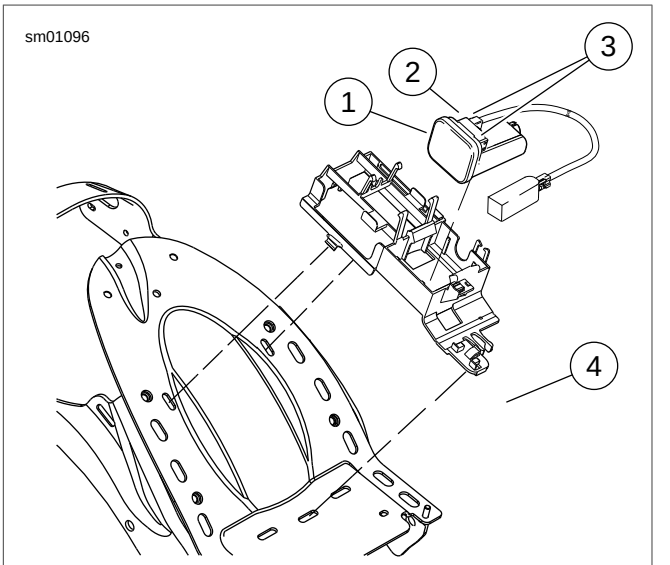
**⚠WARNING**

**Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)**




1. **Passenger seat**
2. **Fastener**
3. **Washer**

**Figure 8-22. Passenger Seat Attachment**




1. **TSSM**
2. **Wiring harness connector**
3. **Connector release latch (2)**
4. **TSSM mounting caddy**

**Figure 8-23. Turn Signal Security Module Mounting**

## GENERAL

See Figure 8-24. The crank position sensor (CKP) (1) is a variable reluctance (VR) sensor that generates an AC signal by sensing the passing of the 22 teeth (2) machined in the left side rotor (3). Two consecutive teeth are missing in the flywheel to establish a reference point. The CKP sensor sends a signal to the ignition module. This signal is used to reference engine position (TDC) and engine speed. The CKP sensor is located near the lower front left corner of the engine crankcase.

## REMOVAL

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

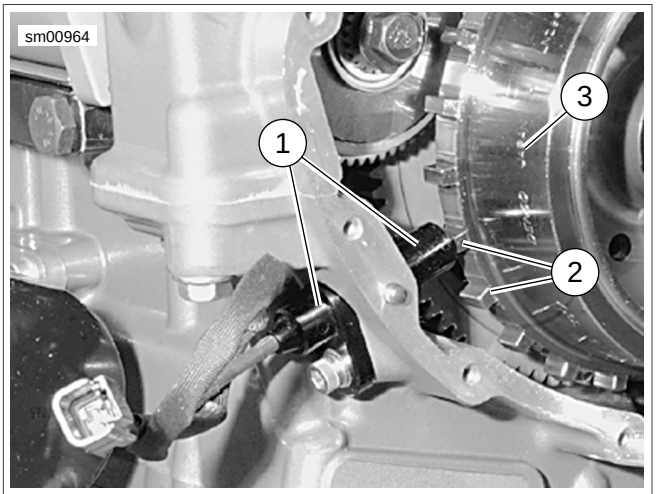
1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove left side radiator trim cover.
3. Clip and remove cable strap securing CKP sensor wiring harness to fan wiring harnesses.
4. Disconnect CKP sensor harness connector [79A].
5. See Figure 8-25. Unlatch cable clip (3) on top of jiffy stand bracket and remove CKP sensor cable harness.
6. Remove fastener and captive washer (2). Carefully remove CKP sensor and o-ring (1) from engine crankcase.

## INSTALLATION

*NOTE*

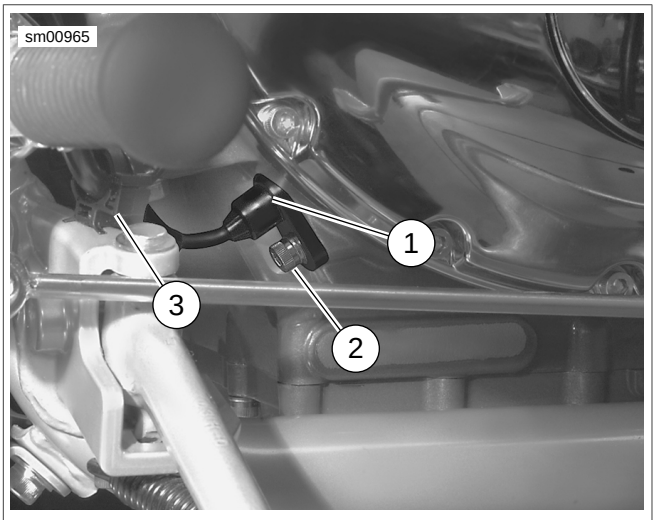
*The **new** CKP o-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the o-ring with engine oil to install it.*

1. See Figure 8-25. Install **new** CKP sensor and o-ring (1) with fastener and captive washer (2). Tighten to 8.2-10.7 Nm (73-95 **in-lbs**).
2. Route CKP sensor wiring harness through cable clip (3) on top of jiffy stand bracket. Latch cable clip.
3. Route CKP sensor wiring harness to wiring harness on left side of radiator and attach to connector [79B].
4. Secure CKP sensor wiring harness to fan wiring harnesses with **new** cable strap.
5. Install left side radiator trim cover. Make sure no wires become pinched under cover.
6. Replace maxi-fuse and right side cover.
7. Start engine and verify operation.




1. **Crank position sensor**
2. **Sensor teeth**
3. **Rotor**

**Figure 8-24. Rotor and Crank Position Sensor**




1. **Crank position sensor and o-ring**
2. **Fastener with captive washer**
3. **Cable clip**

**Figure 8-25. Crank Position Sensor Mounting (typical)**

## GENERAL

The alternator is located behind the alternator cover, on the left side of the engine. The alternator consists of permanent magnets mounted around the circumference of a rotor and a series of radial wire coils statically mounted in a stator assembly. When rotated by the engine, the rotor magnets induce a voltage in the wire coils of the stator alternately reversing polls.

The rotor of the alternator is bolted to the crankshaft. On the crankshaft side of the rotor is a ball clutch mechanism that works in combination with the starter limiter gear to enable the starter ring gear and the rotor/crankshaft to rotate independently of each other. The circumference of the rotor is machined with teeth that identify a reference point for the crank position sensor (CKP).

The stator is bolted to the inside of the alternator cover and delivers induced voltage to a voltage regulator through a wire harness that passes through a boss in the side of the alternator cover.

The alternator cover is secured with 14 fasteners. The derby cover is located on the alternator cover, secured with two fasteners.

*NOTE*

*For diagnostic information, see the VRSC ELECTRICAL DIAGNOSTIC MANUAL.*

**CAUTION**

**The high-output rotor contains powerful magnets. Exercise caution to prevent possible hand injury during removal and installation. (00558b)**

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45304 | ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL |
| HD-45314 | CRANKSHAFT ROTATING WRENCH |
| HD-45315 | ALTERNATOR ROTOR REMOVER |
| HD-45340 | GASKET ALIGNMENT DOWELS |

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove fastener securing bottom of left radiator trim cover. Remove trim cover.
3. See Figure 8-26. Push straight down to remove stator to regulator connector [46] from metal clip on side of radiator cover.
4. Separate stator connector half [46A] from voltage regulator connector [46B] half.
5. Unlatch cable clip on top of jiffy stand and remove alternator wiring harness.

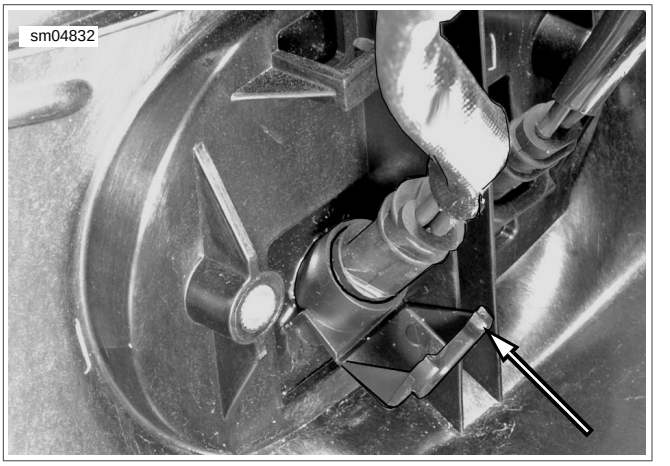
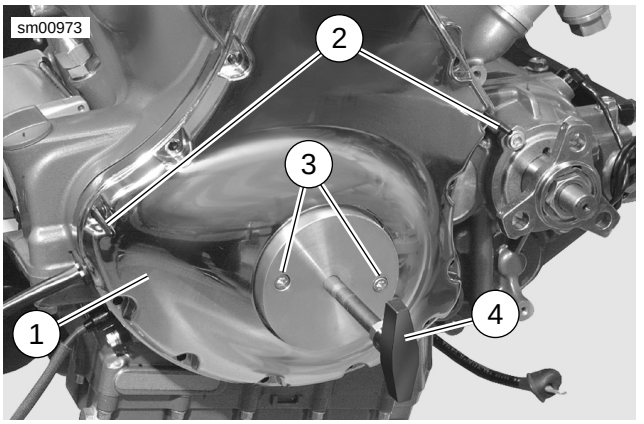



**Figure 8-26. Voltage Regulator Connector Lock Clip**

6. Remove two fasteners securing derby cover. Remove cover.
7. Place drip pan underneath alternator cover to catch any residual oil that may drain out when cover is removed.
8. Remove alternator cover fasteners in reverse order of torque sequence. See 8.13 ALTERNATOR, Installation.
9. Install two GASKET ALIGNMENT DOWELS (Part No. HD-45340) in two of the alternator cover holes to steady cover as it is removed.
10. See Figure 8-27. Using two inspection cover fasteners (3), position ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (Part No. HD-45304) (4) as shown.
11. Remove the alternator cover.
12. Inspect rotor for wear or damage. The rotor and ball clutch assembly for the starter ring gear are replaced as one assembly.
13. Holding 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH (Part No. HD-45314), loosen rotor fastener. Air impact tool may be used for REMOVAL ONLY.
14. Install ALTERNATOR ROTOR REMOVER (Part No. HD-45315) and hand tighten.
15. See Figure 8-28. Use an impact socket and wrench to tighten the tool removing the rotor from the crankshaft taper.
16. To install a rotor assembly, use the following procedure:
    a. Install rotor shell and tighten rotor nut to 83 Nm (60 ft-lbs).
    b. Loosen one full turn.
    c. Tighten to 180 Nm (132 ft-lbs).




1. **Alternator cover**
2. **Gasket alignment dowel (2)**
3. **Derby cover fasteners**
4. **Alternator cover remover/installer tool (HD-45304)**

**Figure 8-27. Removing Alternator Cover**

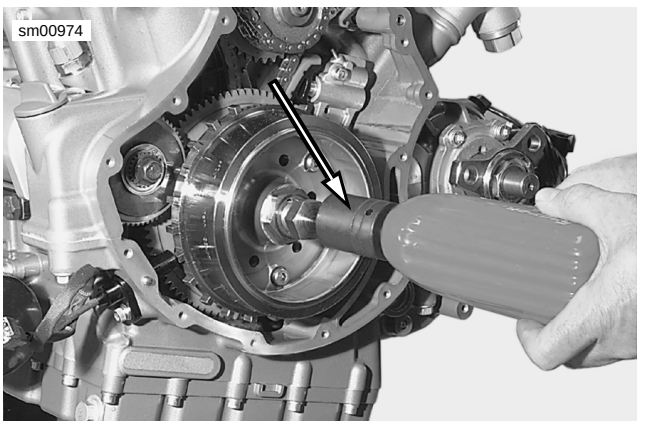
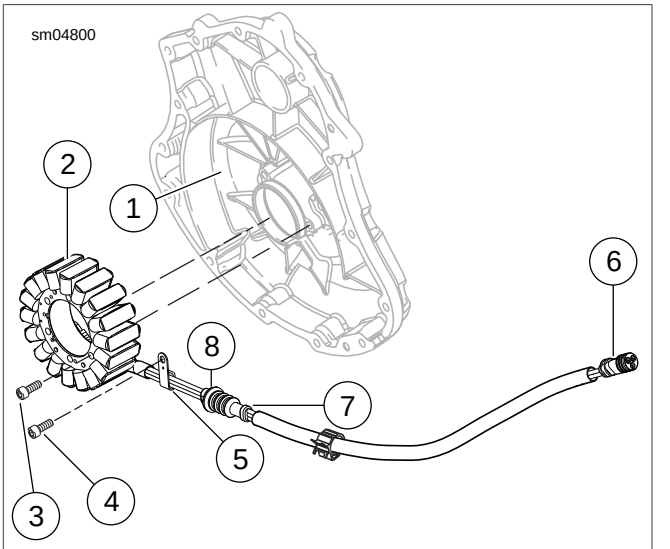



**Figure 8-28. Alternator Rotor Remover (HD-45315)**

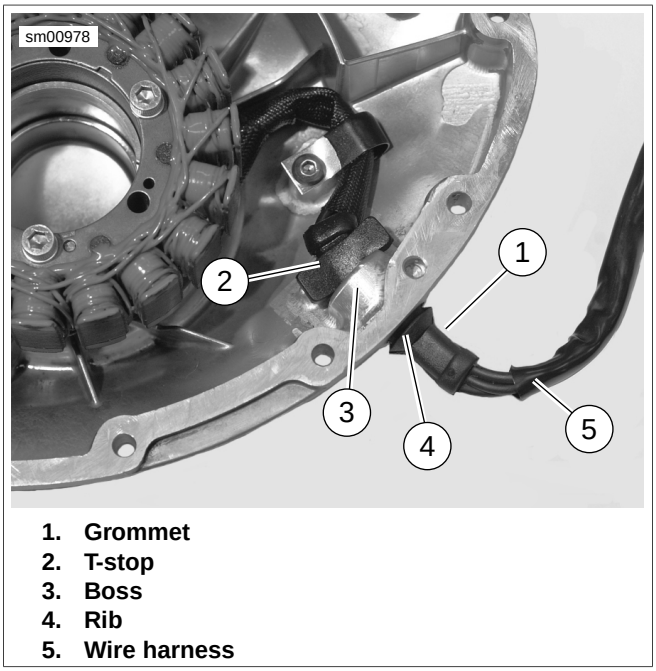
## DISASSEMBLY

1. Remove three wire leads from connector [46A] (6). Insert a pick (Snap-on TT600-3) into square under locking tang and pivot end of pick toward terminal to depress the locking tang. Gently pull on wire to pull terminal from wire end of connector (6).
2. See Figure 8-29. Remove fastener (4) and wire harness clip (5) from alternator cover (1).
3. Remove stator mounting fasteners (3) and captive washers from stator (2). Remove three stator mounting fasteners (3) and pull stator straight up out of alternator cover (1). Note orientation of slot in cover stator hub and clip on stator.
4. Using point of awl, carefully press rib on grommet (7) away from crankcase and then insert awl into bore between grommet and casting.
5. Tilt awl slightly squirting isopropyl alcohol or glass cleaner into opening. Repeat this step at one or two other locations around grommet.
6. See Figure 8-30. While pushing on rib (4) from outside of crankcase, draw grommet (1) through bore by pulling on T-stop (2). Rock grommet back and forth to facilitate removal. Exercise caution to avoid damaging rib on grommet if stator is to be reused.
7. Draw stator wire harness (5) and socket terminals through crankcase bore. For best results, feed one wire and socket terminal at a time.
8. Remove stator and wire harness from alternator cover.




1. **Alternator cover**
2. **Stator**
3. **Stator mounting fasteners (3)**
4. **Fastener**
5. **Harness clip**
6. **Harness connector**
7. **Grommet**
8. **Boss**

**Figure 8-29. Removing Stator From Alternator Cover**




1. **Grommet**
2. **T-stop**
3. **Boss**
4. **Rib**
5. **Wire harness**

**Figure 8-30. Stator Wiring Harness Grommet**

## ASSEMBLY

1. Thoroughly clean alternator cover and gasket sealing surface on engine case. Remove all sealing material from gasket sealing surfaces.
2. See Figure 8-30. From inside cover, feed socket terminals and stator wire harness (5) through boss (3) on cover wall. For best results, feed one wire and socket terminal at a time.
3. Lubricate grommet (1) with isopropyl alcohol or glass cleaner. Grommet must be clean and free of dirt and oily residue.
4. Grasp T-stop (2) behind grommet (1). Push grommet (1) into bore in boss (3) while carefully pulling on outside wire harness (5). Installation is complete when T-stop (2) contacts boss (3) and rib (4) exits crankcase bore.
5. See Figure 8-29. With stator (2) oriented to cover (1) so that wire harness exits alternator cover at approximately 3 o'clock, line up three fastener holes in stator with holes in alternator cover (1).
6. Install three stator mounting fasteners (3) and alternately tighten to 8.2-10.7 Nm (72-95 **in-lbs**).
7. Install harness clip (5) over wire harness into alternator cover. Secure with fastener (4). Tighten to 8.2-10.7 Nm (72-95 **in-lbs**).
8. Push wire socket terminals into connector [46A].

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45304 | ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL |
| HD-45340 | GASKET ALIGNMENT DOWELS |

1. See Figure 8-27. Make sure ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (Part No. HD-45304) (4) is installed as shown. Secure to alternator cover with two derby cover fasteners. Turn handle of tool clockwise (CW) several turns.
2. Make sure two GASKET ALIGNMENT DOWELS (Part No. HD-45340) (2) are installed in case.
3. Slide **new** alternator cover gasket onto alignment dowels and press flush against engine case.
4. Slide alternator cover onto alignment dowels. Turn handle of remover/installer counterclockwise (CCW) until it turns freely. Remove two derby cover fasteners and remover/installer tool.

*NOTE*

*To avoid oil leaks caused by warping of alternator cover, in next step, tighten fasteners in alternating pattern back and forth across face of cover. See Figure 8-31.*

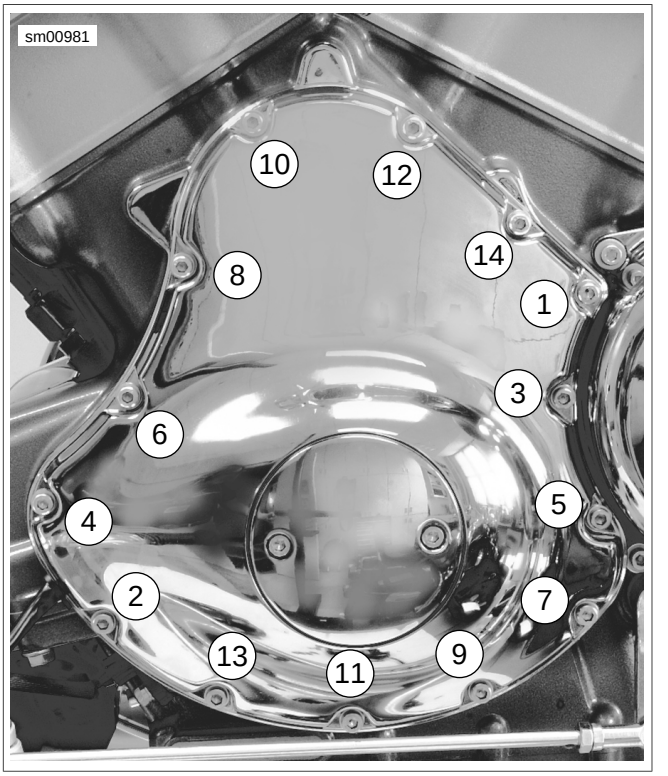



**Figure 8-31. Alternator Cover Torque Sequence Fasteners @ 9.7 Nm (86 in-lbs)**

5. See Figure 8-31. Secure alternator cover to engine case with 14 fasteners. Tighten to 9.7 Nm (86 **in-lbs**).
6. Clean derby cover. Inspect O-ring on derby cover. Replace if damaged.

7. Install derby cover on alternator cover with two fasteners. Tighten to 8.2-10.7 Nm (72-95 **in-lbs**).
8. Route stator wiring harness through cable clip on top of jiffy stand. Latch cable clip.
9. Plug stator connector into three-wire voltage regulator connector. Secure connector to left side of radiator cover with connector clip.
10. Install radiator trim cover onto radiator cover. Make sure no wires become pinched under cover. Secure with fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).

## GENERAL

The instrument cluster contains the speedometer, tachometer, fuel gauge and indicator lamps. It is a sealed unit. If any of the instruments or indicator lamps becomes defective, the entire instrument cluster must be replaced.

## REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. See Figure 8-32. To free lower end of top handlebar cover, loosen two mounting fasteners holding headlamp bracket to upper triple clamp.
3. Without removing cover, remove two fasteners (6) securing handlebar top cover (2) and instrument housing bezel (1) to handlebar bottom cover (5).

*NOTE*

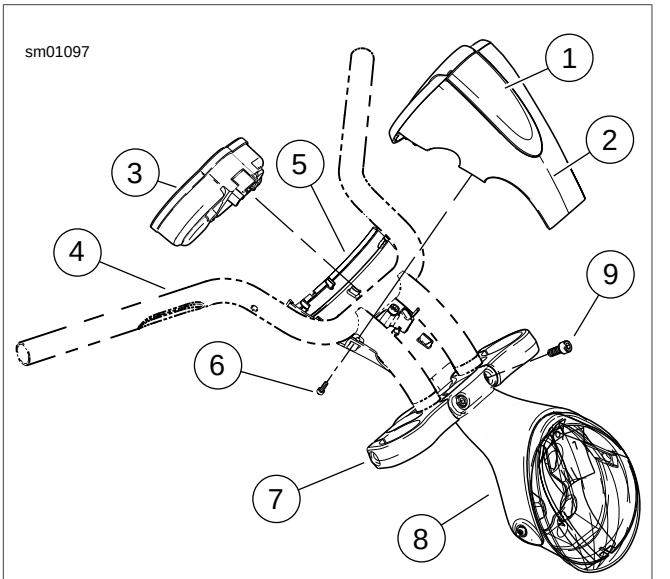
*See Figure 8-33. Bezel hook holds bottom of bezel and top cover to lower handlebar cover and can be damaged if forced during removal or installation.*

4. From headlamp bracket end of cover, gently tilt top handlebar cover and instrument bezel up and back to remove cover and bezel.

*NOTE*

*Bezel can remain snapped to upper handlebar cover.*

5. See Figure 8-34. Squeeze two release latches together and gently pull wiring harness connector [39] from instrument cluster socket.
6. Remove instrument cluster from handlebar bottom cover.




1. **Instrument housing bezel**
2. **Handlebar top cover**
3. **Instrument cluster**
4. **Handlebars**
5. **Handlebar bottom cover**
6. **Fastener (2)**
7. **Upper triple clamp**
8. **Headlamp and headlamp bracket**
9. **Fastener (2)**

**Figure 8-32. Instrument Cluster Removal**

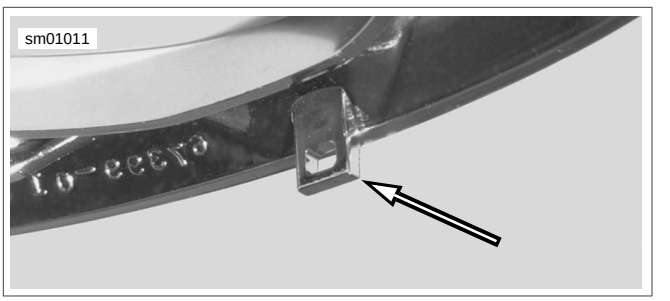
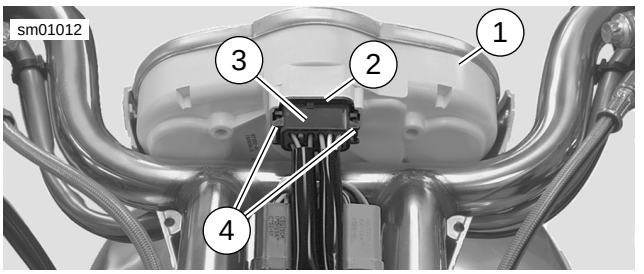



**Figure 8-33. Bezel Hook**




1. **Instrument cluster**
2. **Instrument cluster socket**
3. **Wiring harness connector [39]**
4. **Release latch (2)**

**Figure 8-34. Instrument Cluster Harness Connector [39]**

## INSTALLATION

1. Set **new** instrument cluster into handlebar bottom cover.
2. See Figure 8-34. Install wiring harness connector into instrument cluster socket. Gently push connector into socket until release latches lock into place.

*NOTE*

*See Figure 8-33. Bezel hook holds bottom of bezel and top cover to lower handlebar cover and can be damaged if forced during removal or installation.*

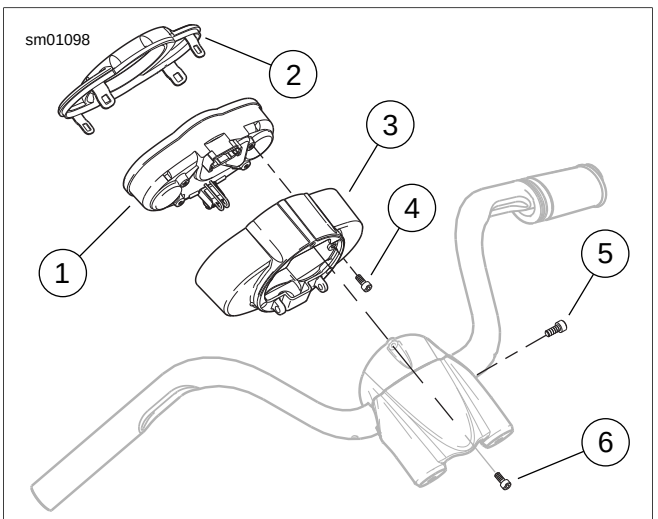
3. See Figure 8-32. Orient instrument housing bezel and handlebar top cover, and fit bezel hook over tab on handlebar bottom cover. Gently press handlebar top cover and instrument housing bezel down until bezel hook snaps onto tab.
4. Fit bottom end of handlebar top cover behind headlamp mounting bracket. Bezel edge should fit snugly to grooved rim of lower and upper cover.
5. Secure handlebar covers with two fasteners. Tighten fasteners to 1.3-1.9 Nm (12-16 **in-lbs**).
6. Tighten headlamp bracket fasteners to 11-18 Nm (8-13 ft-lbs).
7. Replace maxi-fuse and right side cover.
8. Verify that instrument cluster is operational:
   a. Turn ignition/seat release switch to the ACC position. Instrument background lighting will illuminate, gauge needles will sweep their full range of motion and the battery, security, coolant temperature and check engine indicator lamps will illuminate.
   b. Turn ignition/seat release switch to the LOCK position.

## GENERAL

The instrument cluster contains the speedometer, tachometer, fuel gauge and indicator lamps. It is a sealed unit. If any of the instruments or indicator lamps becomes defective, the entire instrument cluster must be replaced.

## REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. See Figure 8-35. Remove fastener at top of instrument housing.
3. Holding instrument housing to prevent damage to air box cover, rotate housing open.
4. See Figure 8-36. Squeeze two release latches together and pull wiring harness connector [39B] from instrument cluster.
5. See Figure 8-35. Loosen and remove hinge fastener and slide housing off of hinge peg.
6. Remove four fasteners and separate housing, instrument cluster and bezel.




1. **Instrument cluster**
2. **Bezel**
3. **Instrument housing**
4. **Fastener**
5. **Hinge fastener**
6. **Top housing fastener**

**Figure 8-35. VRSCD Instrument Cluster**

## INSTALLATION

1. See Figure 8-35. Assemble bezel, instrument cluster and housing. Install and tighten fasteners to 1.3-1.9 Nm (12-16 **in-lbs**).
2. Fit hinge of housing to peg on handlebar clamp. Install and tighten fastener to 2.2-2.8 Nm (20-24 **in-lbs**).
3. Squeeze two release latches together and mate connector [39B] to instrument cluster.
4. Close housing. Install and tighten top housing fastener to 2.2-2.8 Nm (20-24 **in-lbs**).
5. Replace maxi-fuse and right side cover.
6. Verify that instrument cluster is operational:
   a. Turn ignition/seat release switch to the ACC position. Instrument background lighting will illuminate, gauge needles will sweep their full range of motion and the battery, security, coolant temperature and check engine indicator lamps will illuminate.
   b. Turn ignition/seat release switch to the LOCK position.

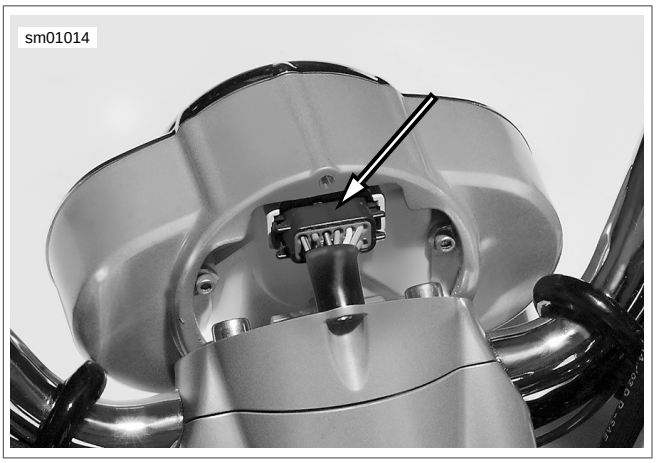



**Figure 8-36. Instrument Cluster Connector [39B]**

## GENERAL

The vehicle speed sensor (VSS) is a hall effect sensor that takes readings off a drive gear in the transmission.

The VSS is located behind the rear cylinder on the back of the engine case, below the cam chain tension adjuster.

## REMOVAL

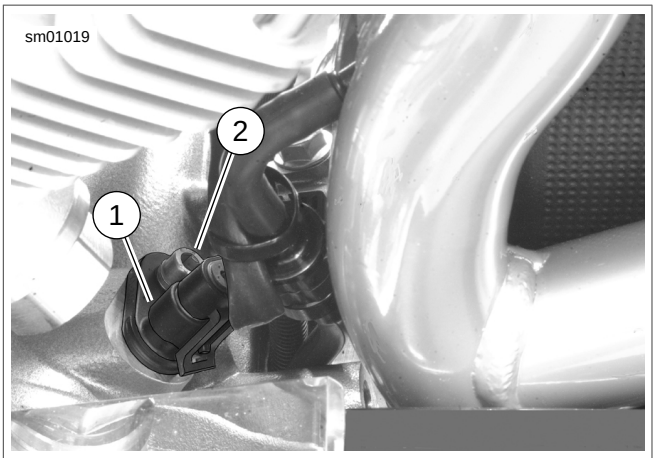
1. Remove right side cover and maxi-fuse.
2. See Figure 8-37. Disconnect VSS wiring harness cable connector [65B] from the VSS.
3. Remove the fastener securing the VSS. Carefully pull the VSS and o-ring straight out of the transmission case.

## INSTALLATION

*NOTE*

*The **new** VSS o-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the o-ring with engine oil to install it.*

1. See Figure 8-37. Install **new** VSS with o-ring, and fastener (2). Tighten to 8.2-10.7 Nm (73-95 **in-lbs**).
2. Install maxi-fuse and side cover.




**1. Vehicle speed sensor**
**2. Fastener**

**Figure 8-37. Vehicle Speed Sensor (typical)**

## GENERAL

The neutral switch is located on the bottom of the engine case near the rear of the engine. The two-terminal switch is normally closed. When the transmission is in neutral and the ignition switch is in the IGN position, the neutral switch causes the NEUTRAL indicator lamp to illuminate.

## REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Make sure transmission is shifted into NEUTRAL.
3. Place a clean container under motorcycle to catch any oil that may escape.
4. See Figure 8-38. Remove two wiring harness connectors (2) from neutral switch (1). Gently pull connectors straight off switch studs.
5. Using a 7/8 in. box wrench, remove neutral switch and o-ring from engine case.

## INSTALLATION

*NOTE*

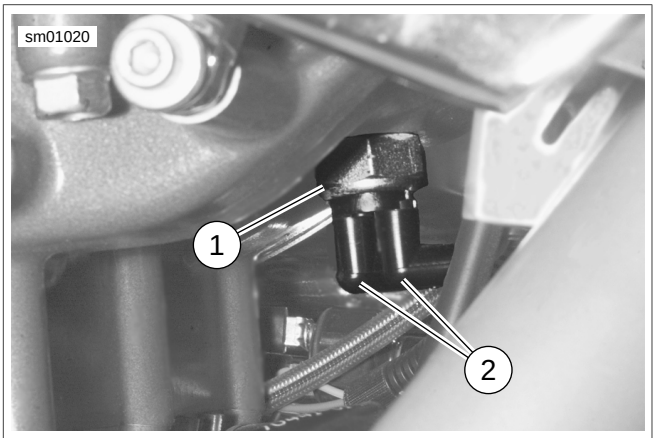
*The transmission shifter must be in the NEUTRAL position when installing the switch to allow the switch ball to engage the shifter cam ramp.*

1. See Figure 8-39. Lubricate **new** o-ring (2) with engine oil.
2. Install neutral switch with o-ring into engine case. Tighten to 12.8-16.5 Nm (113-146 **in-lbs**).

*NOTE*

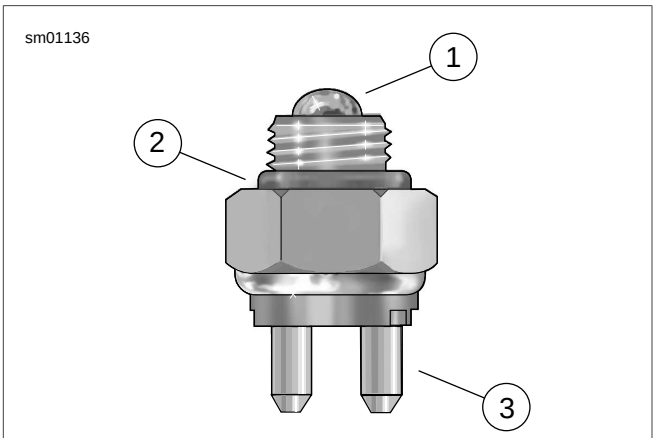
*The neutral switch is not polarity sensitive. Either connector may be attached to either stud.*

3. See Figure 8-38. Install wiring harness connectors (2) onto studs on neutral switch (1). Gently push connectors until they bottom out on studs.
4. Replace maxi-fuse and right side cover.
5. Test neutral switch for proper operation.
   a. Turn ignition switch to IGN position.
   b. Verify that transmission shifter is in NEUTRAL.
   c. Check to see that NEUTRAL indicator lamp illuminates.
   d. Turn off ignition switch.
6. If any oil escaped while neutral switch was removed from vehicle, check the engine oil level. See 1.8 ENGINE OIL AND FILTER. Replenish engine oil as necessary.




**1. Neutral switch**
**2. Wiring harness connectors (2)**

**Figure 8-38. Neutral Switch Location (typical)**




**1. Ball**
**2. O-ring**
**3. Switch stud**

**Figure 8-39. Neutral Switch (typical)**

## GENERAL

The oil pressure switch monitors oil pressure in the crankcase. If the oil pressure drops below 13.8-34.5 kPa (2-5 psi), the oil pressure switch is tripped and illuminates the low oil pressure indicator light. The oil pressure switch is located in the valley on top of the engine crankcase between the cylinders.

## REMOVAL

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45300 | OIL PRESSURE SWITCH SOCKET |

1. Open seat.
2. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.

**CAUTION**

**Cover the throttle body bores with duct tape to prevent objects from falling down the injector bores. Do NOT use shop cloths or objects that could damage the throttle plates. (00212d)**

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)**

3. Disconnect negative battery cable.
4. Remove horn assembly.
5. Remove MAP sensor.
6. Remove the idle air control (IAC) motor wiring harness connector [87B] and throttle position sensor (TPS) connector [88B] from the fuel injector assembly. Tuck the wiring harnesses back out of the way.
7. See Figure 8-40. Remove the wiring harness connector from the oil pressure switch.

*NOTES*

- *The engine in the figure has been stripped to clarify the location of the oil pressure switch.*
- *It will be necessary to use a universal adapter and extension with the oil pressure switch socket in the next step to fully seat the socket on the oil pressure switch. In place of a universal adapter and standard extension, a Snap-on Wobble Extension, such as the FXW8 or FXW11A may be used.*

*NOTE*

*When removing the oil pressure switch, take care to avoid damaging wiring connectors and sensor bodies located nearby.*

8. Using OIL PRESSURE SWITCH SOCKET (Part No. HD-45300), remove the oil pressure switch.

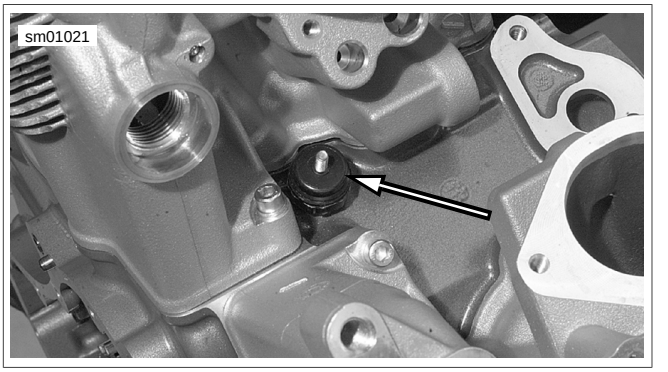



**Figure 8-40. Oil Pressure Switch (typical)**

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45300 | OIL PRESSURE SWITCH SOCKET |

*NOTE*

*Perform step 1 below only if original oil pressure switch is being re-installed. New switches have a sealant contact patch on the threads. If new switch is being installed, begin with step 2.*

1. Coat threads of oil pressure switch with LOCTITE® High Performance Pipe Sealant with Teflon (LOCTITE® Part No. PST565).
2. Using OIL PRESSURE SWITCH SOCKET (Part No. HD-45300), install oil pressure switch. Tighten to 10.8-13.6 Nm (96-120 **in-lbs**).
3. Attach wiring connector to oil pressure switch.
4. Attach IAC motor and TPS sensor wiring harness connectors [87B] and [88B].
5. Install MAP sensor.
6. Install horn assembly.
7. Connect negative battery cable. Tighten bolt to 6.8-10.8 Nm (60-96 **in-lbs**).
8. Remove duct tape from injector intakes.
9. Replace airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
10. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.
11. Test oil pressure switch for proper operation.

# STOPLIGHT SWITCH: FORWARD MOUNT CONTROLS 8.19

## GENERAL

The stoplight switch monitors brake fluid pressure in the rear brake line. When the vehicle operator steps on the rear brake pedal and pressure in the brake line reaches a preset level, the stoplight switch is tripped and illuminates the stop light. The stoplight switch is located on the rear brake line T-fitting.

## REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Open seat.
3. Remove exhaust mufflers and collector. See appropriate exhaust system removal for your model.
4. See Figure 8-41. Remove two wiring harness terminal connectors (1) from stoplight switch (2).
5. Place a clean container under stoplight switch and brake line to catch escaping fluid.
6. Using a 1-inch open end wrench, remove stoplight switch from T-fitting (3).

## INSTALLATION

*NOTE*

*Perform step 1 below only if original rear stoplight switch is being re-installed. New switches have a sealant contact patch on the threads. If new switch is being installed, begin with step 2.*

1. Coat threads of stoplight switch with LOCTITE® High Performance Pipe Sealant with Teflon (LOCTITE® Part No. PST565).
2. Install stoplight switch to brake line T-fitting. Tighten switch with a 1-inch open end wrench.
3. Attach two wiring harness terminal connectors to stoplight switch.
4. Install exhaust collector and mufflers. See appropriate exhaust system removal for your model.
5. Close seat.

**CAUTION**

**When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged. (00196a)**

**⚠WARNING**

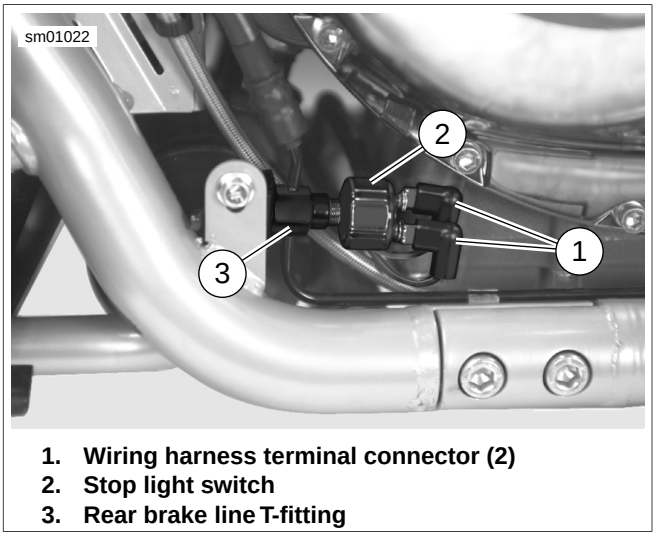
**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

6. Bleed brake system. See 1.12 BLEEDING BRAKES.

**⚠WARNING**

**Be sure headlamp, tail and stop lamp and turn signals are operating properly before riding. Poor visibility of rider to other motorists can result in death or serious injury. (00478b)**

7. Replace maxi-fuse and right side cover.
8. Check tail lamp/stoplight for proper operation.




1. **Wiring harness terminal connector (2)**
2. **Stop light switch**
3. **Rear brake line T-fitting**

**Figure 8-41. Stop Light Switch (NON-ABS forward-mount controls shown)**

## GENERAL

The stoplight switch monitors brake fluid pressure in the rear brake line. When the vehicle operator steps on the rear brake pedal and pressure in the brake line reaches a preset level, the stoplight switch is tripped and illuminates the stoplight. The stoplight switch is located on the rear brake line T-fitting.

## REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove exhaust mufflers and collector. See appropriate exhaust system removal for your model.
3. See Figure 8-42. Remove wiring harness terminal connector (1) from stoplight switch (2).
4. Place a clean container under stoplight switch and brake line to catch escaping fluid and protect any painted parts.
5. Using an open end wrench, remove stoplight switch from brake hose fitting (3).

## INSTALLATION

*NOTE*

*Perform step 1 below only if original rear stoplight switch is being re-installed. New switches have a sealant contact patch on the threads. If new switch is being installed, begin with step 2.*

1. Coat threads of stoplight switch with LOCTITE® High Performance Pipe Sealant with Teflon (LOCTITE® Part No. PST565).
2. Install brake hose fitting to stoplight switch using a **new** brake line washer on each side of brake hose fitting. and install into rear brake master cylinder. Tighten switch with an open end wrench to 23-29 Nm (17-21 ft-lbs).
3. Attach wiring harness terminal connector to stoplight switch.
4. Install exhaust collector and mufflers. See appropriate exhaust system section for your model.

**WARNING**

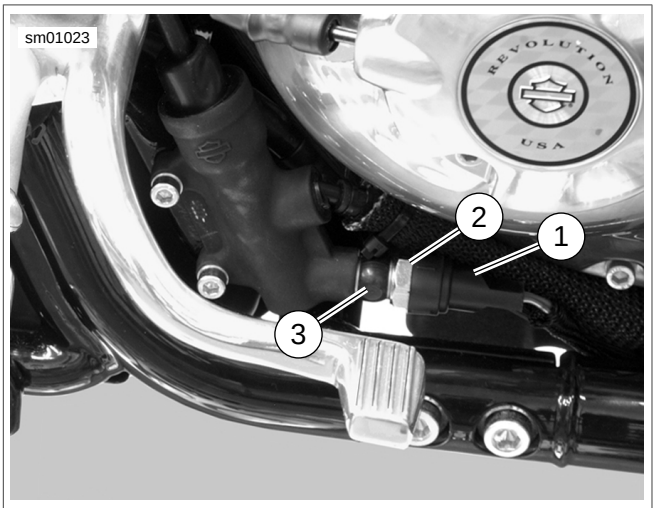
**After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)**

5. Bleed brake system. See 1.12 BLEEDING BRAKES.
6. Replace maxi-fuse and right side cover.

**WARNING**

**Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)**

7. Check tail lamp/stoplight for proper operation.




1. **Wiring harness terminal connector (2)**
2. **Stoplight switch**
3. **Rear brake hose fitting**

**Figure 8-42. Stoplight Switch (NON-ABS mid-mount controls shown)**

## INSPECTION

The horn is located on the left side of the motorcycle, mounted under the top frame rail, between the engine cylinder heads.

If the horn fails to sound or does not sound satisfactorily, check for loose, frayed or damaged horn terminal wires, discharged battery or corroded ground.

The horn is permanently sealed and non-repairable. If defective, it must be replaced.

*NOTE*

*No tonal adjustments can be made to this horn.*

## REPLACEMENT

1. See Figure 8-43. Remove acorn nut (1) and washer (2) and detach horn assembly from motorcycle.
2. Remove ground wire (9) and horn power wire (10) from posts on back side of horn (8).
3. Remove nut (7) securing horn to mounting bracket (6).

*NOTES*

- *When tightening the flange nut in the next step, make certain the horn does not come in contact with the horn cover. If it does, loosen the flange nut, reposition the horn, and retighten the flange nut.*
- *Over-tightening the flange nut can cause permanent horn damage resulting in reduced volume and tone quality.*

4. Install **new** horn on bracket. Secure with flange nut (7). Tighten to 6-8 Nm (53-70 **in-lbs**).
5. See Figure 8-44. Attach wiring.
   a. Connect BK ground wire to silver post (2).
   b. Connect Y/BK horn power wire to copper post (3).

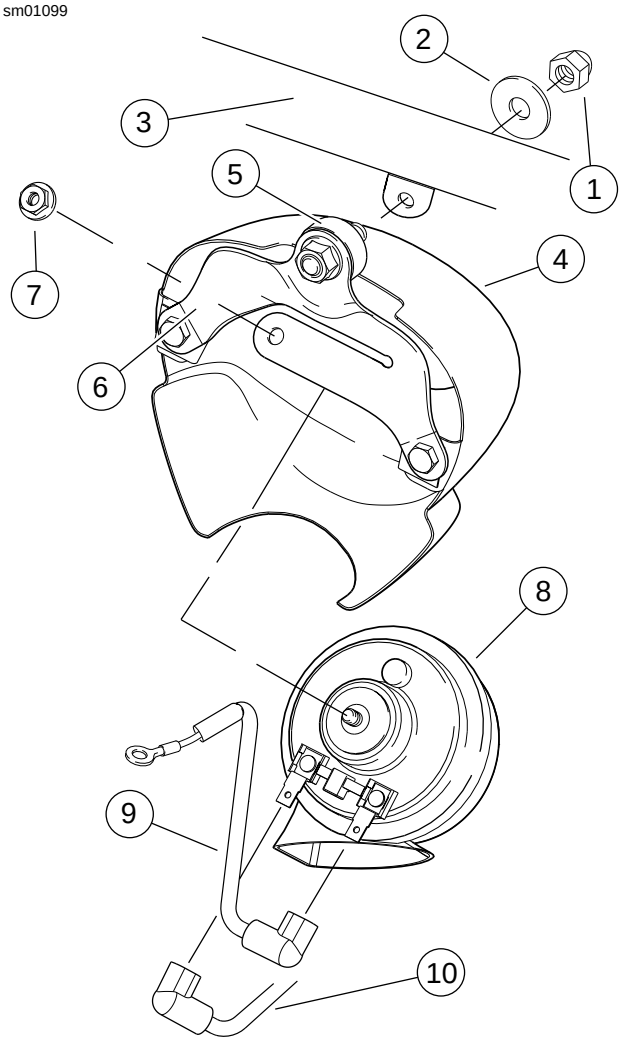
*NOTE*

*Improperly installed horn can strike fins on the cylinder heads during operation. The interference can cause substantial cosmetic damage.*

6. See Figure 8-43. Attach horn assembly to motorcycle using washer (2) and acorn nut (1). Tighten to 9-15 Nm (80-132 **in-lbs**).

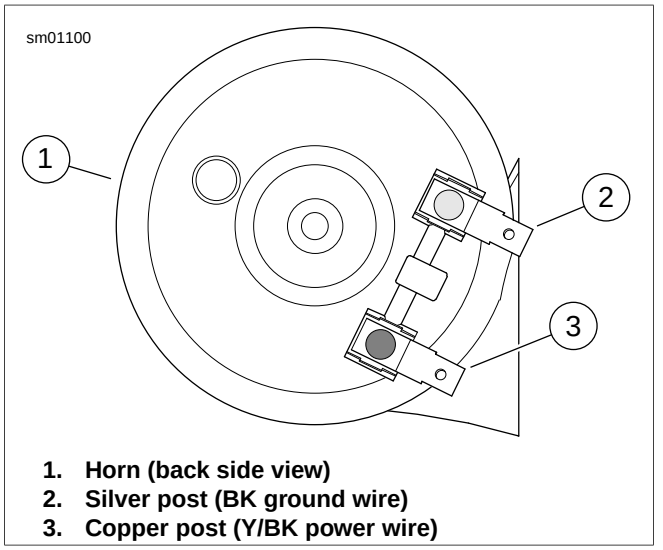
*NOTE*

*When tightening the acorn nut in the next step, make certain the horn cover does not come in contact with the fins on the cylinder heads. If it does, loosen the acorn nut, reposition the horn assembly and retighten the nut.*




1. **Acorn nut**
2. **Washer**
3. **Motorcycle frame**
4. **Horn cover**
5. **Rubber mount**
6. **Horn mounting bracket**
7. **Flange nut**
8. **Horn**
9. **Ground wire**
10. **Horn power wire**

**Figure 8-43. Horn (typical)**




1. **Horn (back side view)**
2. **Silver post (BK ground wire)**
3. **Copper post (Y/BK power wire)**

**Figure 8-44. Horn Wiring (typical)**

## GENERAL

The two cooling fans are mounted one above the other in a single assembly behind the radiator. The cooling fans are controlled electronically and are turned on and off as necessary to maintain an acceptable coolant temperature range.

**⚠CAUTION**

**Cooling fans operate automatically, even when the ignition switch is off. Keep hands away from fan blades. Contact with a rotating fan blade can result in minor or moderate injury. (00093a)**

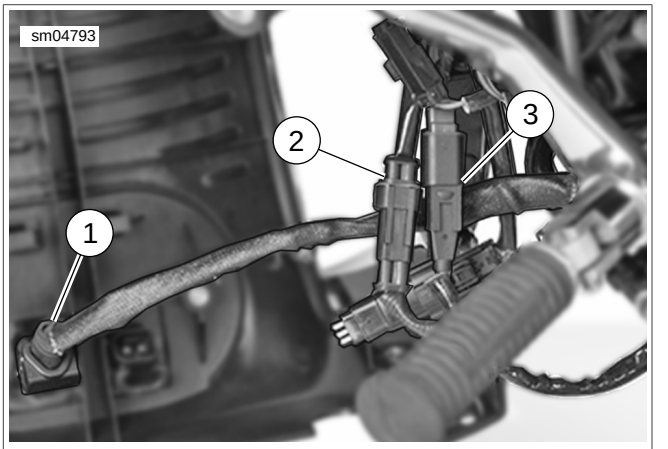
## REMOVAL

1. Remove right side cover and maxi-fuse. See 8.4 MAXI-FUSE.
2. Remove fastener and right radiator trim cover.
3. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.
4. Remove fastener and left radiator trim cover.

*NOTE*

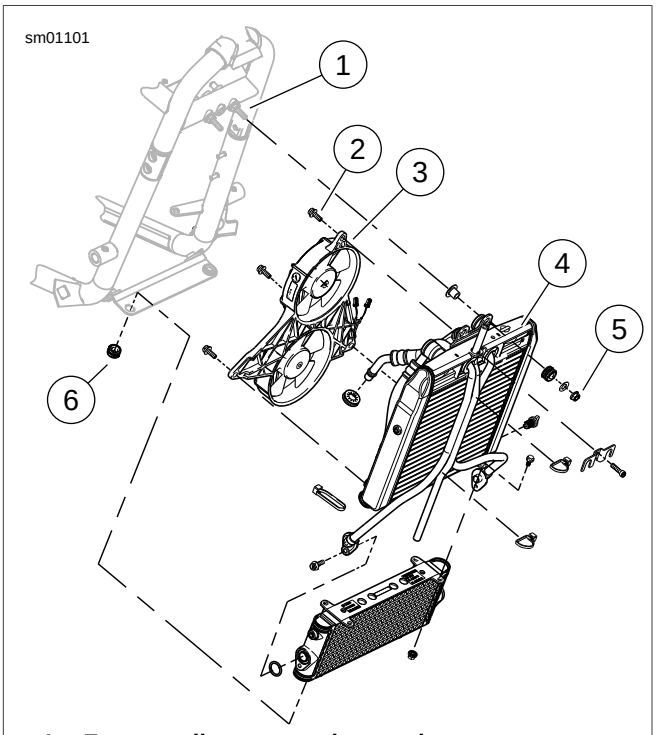
*Before removing wiring harnesses, carefully note wire routing. In particular, pay close attention to locations of cable wraps that must be replaced.*

5. See Figure 8-45. Clip cable wrap used to secure cooling fan wire harness to crankshaft position sensor (CKP) harness.
6. Push connectors and wire harnesses away from coolant drain plug up and behind shift lever.
7. Place a container under left side of radiator. See 6.3 ENGINE COOLANT.
8. Loosen but do not remove coolant drain plug. Turn drain plug until slot in threads drains into container.
9. Open seat and remove pressure cap to accelerate coolant drain from radiator.
10. Hand tighten coolant drain plug.
11. Place a container under engine, remove oil filler plug/dipstick, and oil drain plug and drain oil. Reinstall dipstick and drain plug. See 1.8 ENGINE OIL AND FILTER.
12. Separate top and bottom cooling fan connectors (2).
13. Separate crank position sensor connector (3).
14. Cover front fender with shop towel or protective cover. Remove fasteners and washers on each side of radiator cover. Remove radiator cover with chrome inlet bezels attached.
15. Remove the radiator and oil cooler assembly. See 6.8 RADIATOR AND OIL COOLER.
16. Separate oil line quick connect fittings. See 6.7 OIL LINE FITTINGS.




1. **Stator-to regulator connector**
2. **Top & bottom fan power connectors**
3. **Crank position sensor connector**

**Figure 8-45. Left Side Wiring Connectors (typical)**




1. **Frame radiator mounting studs**
2. **Fan fasteners**
3. **Cooling fan assembly**
4. **Radiator**
5. **Fasteners**
6. **Cross member grommet**

**Figure 8-46. Radiator Mounting (typical)**

## DISASSEMBLY

1. See Figure 8-47. Remove two lower mounting fasteners (1) on fan assembly.

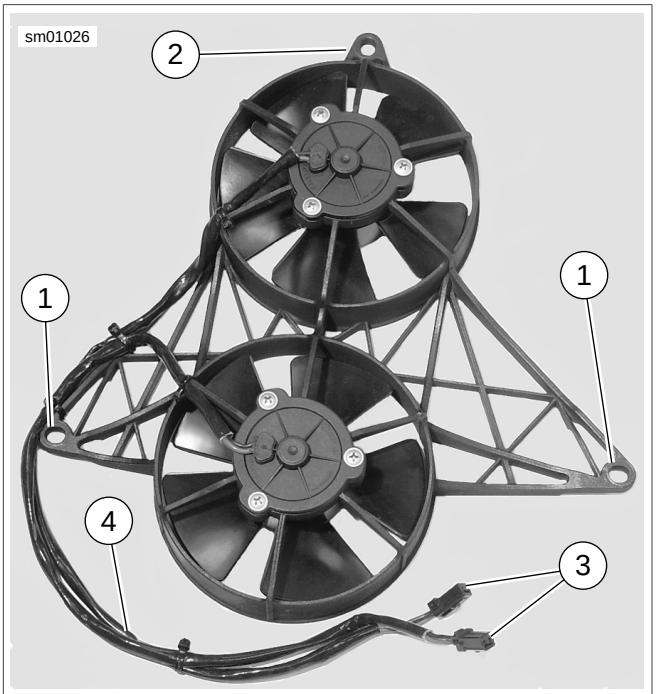
2. Loosen upper radiator mounting fastener (2).
3. Remove the cooling fan assembly.

## ASSEMBLY

1. See Figure 8-47. Install cooling fan assembly with fan wiring harness to left side of radiator.
2. See Figure 8-46. Thread in and tighten fan fasteners (1, 2) to 5-7 Nm (44-62 **in-lbs**).

## INSTALLATION

1. Install radiator/oil cooler assembly. See 6.8 RADIATOR AND OIL COOLER.
2. Mate oil lines quick connect lines. See 6.7 OIL LINE FITTINGS.
3. Mount radiator cover with fasteners and washers. Tighten to 4.1-6.8 Nm (36-60 **in-lbs**).
4. See Figure 8-45. Cable wrap cooling fan wiring harnesses to crankshaft position sensor (CKP) wiring harness.
5. Mate cooling fan wiring harness connectors.
6. Install left side radiator trim cover and fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).
7. Push rear brake master cylinder reservoir into mounting slots in right side of radiator cover.
8. Install right radiator trim cover and fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).
9. Fill radiator with engine coolant. See 6.3 ENGINE COOLANT.
10. Fill engine with oil. See 1.8 ENGINE OIL AND FILTER.
11. Replace maxi-fuse and right side cover.
12. Test cooling fan operation. See Electrical Diagnostic Manual.




1. **Lower mounting fastener locations**
2. **Upper mounting fastener location**
3. **Connectors**
4. **Wiring harness**

**Figure 8-47. Cooling Fan Assembly**

## GENERAL

The switches are of rugged construction and feature a superior seal to protect electrical contacts and components from dirt and moisture in harsh environments.

The left handlebar switches include the headlamp HI - LO switch, horn and left turn signal switch. The right handlebar switches include the engine start and RUN - OFF switch and right turn signal switch. The individual switches are non-repairable and must be replaced if they malfunction.

*NOTES*

- *On certain models, the turn signal wiring is routed through the lower switch housings and handlebars.*
- *To replace or repair individual switches in either the right or left handlebar switch assemblies, see 8.24 RIGHT HANDLEBAR SWITCH or 8.25 LEFT HANDLEBAR SWITCH.*

## REPAIR PROCEDURES

| PART NUMBER | TOOL NAME |
|---|---|
| HD-25070 | ROBINAIR HEAT GUN |
| HD-39969 | ULTRA TORCH UT-100 |
| HD-41183 | HEAT SHIELD ATTACHMENT |

See 8.24 RIGHT HANDLEBAR SWITCH and 8.25 LEFT HANDLEBAR SWITCH. The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.

The information below is useful when repairing handlebar switch assemblies.

1. To better access wires and avoid damaging conduit with radiant heating device, push conduit back and secure with extra 177.8 mm (7.0 in.) cable strap in kit.
2. Strip 12.7 mm (0.5 in) of insulation off switch wires. Twist stripped ends of switch wires until all strands are tightly coiled.
3. Cut dual wall heat-shrink tubing, supplied in repair kit into 25.4 mm (1.0 in.) segments. Slide tubing over each wire of **new** switch assembly.
4. Splice existing and **new** switch wires, matching wire colors. Solder the spliced connections. For best results, do one wire at a time.
5. Center the heat-shrink tubing over the soldered splices.

**⚠WARNING**

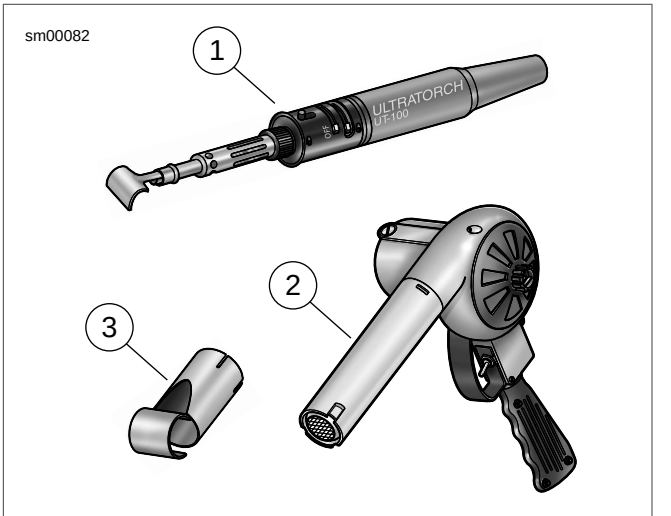
**Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)**

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
- Always keep hands away from tool tip area and heat shrink attachment.

6. See Figure 8-48. Using the ULTRA TORCH UT-100 (Part No. HD-39969) or ROBINAIR HEAT GUN (Part No. HD-25070) with HEAT SHIELD ATTACHMENT (Part No. HD-41183) or other suitable radiant heating device, uniformly heat the heat-shrink tubing to insulate and seal the soldered connections. Apply heat just until the meltable sealant exudes out both ends of tubing and it assumes a smooth cylindrical appearance.
7. Inspect the melted sealant for solder beads. Excess solder or heat may force some solder out with the melted sealant. Use a small needle nose pliers to remove any solder found. Briefly heat the connection to reseal the tubing if solder beads were removed. Use less solder or reduce heating time or intensity when doing subsequent splices.

**⚠WARNING**

**Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)**




1. **Ultra Torch UT-100**
2. **Robinair Heat Gun**
3. **Robinair Heat Gun Shrink Tool Attachment**

**Figure 8-48. Radiant Heating Devices**

## REMOVAL

*NOTE*

*The removal and installation steps listed apply when replacing a switch housing and its wire harness. Replacing a switch housing alone, repairing a switch housing, or replacing handlebars will not require removal of the wire harness to the switch housing.*

1. Remove maxi-fuse. See 8.4 MAXI-FUSE.
2. See Figure 8-49. If removing the switch housing and wire harness, remove the left side cover and locate the right switch housing connector [22].
3. Depress the latch on the socket housing and separate the switch housing connector halves.
4. Remove secondary locking wedge and depress terminal latches inside socket housing to remove socket terminals and wires.

**CAUTION**

**Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)**

5. See Figure 8-50. Place the cardboard insert between the brake lever and lever bracket.
6. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the master cylinder housing. Remove the brake lever/master cylinder assembly and clamp from the handlebar.
7. Using a T25 TORX drive head, remove the upper and lower switch housing screws.




**Figure 8-49. Right Switch Housing Connector [22] (typical)**

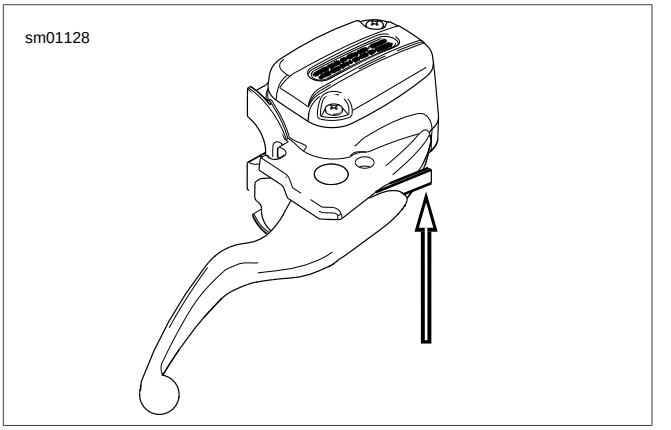



**Figure 8-50. Install 4 mm (5/32 in.) Thick Cardboard Insert**

8. To remove the housing with the wire harness, wrap switch housing wires to wire lead and pull wires through opening in upper fork clamp. Leave wire lead in fork clamp.
9. Remove the friction shoe from the end of the tension adjuster screw.

*NOTE*

*The friction screw is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.*

10. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
11. Remove the throttle control grip from the end of the handlebar.
12. Pull the crimped inserts at the end of the throttle and idle control cable housings from the lower switch housing. For best results, use a rocking motion while pulling. Place a drop of light oil on the retaining rings, if necessary. Remove the cables from the switch housing.
13. Pull the wire harness through the handlebar clips and remove the housing and wire harness.

## INSTALLATION

1. Thread the lose ends of the wire harness through the handlebar clips. Wrap the free ends of the wire harness to the wire lead and pull through the opening in the upper fork clamp.
2. Route wire harness around steering head.
3. Crimp socket terminals on ends of wire and push through connector wire seal and into socket housing.
4. Install internal seal and locking wedge.
5. Mate connector [22] halves.
6. Assemble the switch housing. With the concave side facing upward, install the friction shoe so that the pin hole is over the point of the adjuster screw.

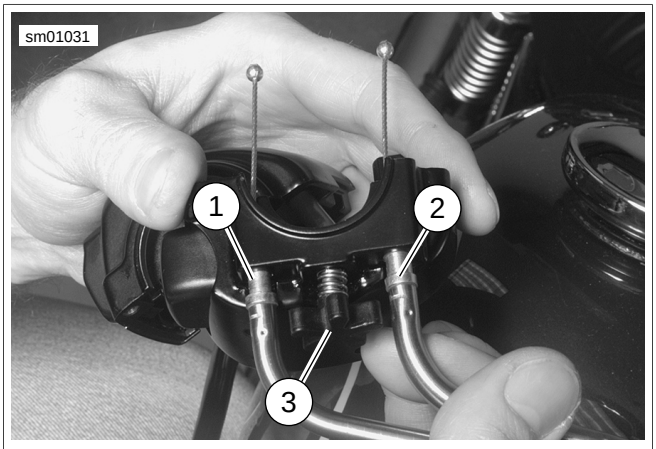
*NOTE*

*The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.*

7. See Figure 8-51. Push the throttle and idle control cables into the lower switch housing until they snap in place. Note the different diameter inserts crimped into the end of the throttle and idle cable housings.
   a. Push the silver insert of throttle cable housing into the hole in front of tension adjuster screw.
   b. Push the gold insert (1) of idle cable housing into the hole at the rear of tension adjuster screw.

*NOTE*

*To aid assembly, place a drop of light oil on the retaining rings of the crimped inserts. Always replace the retaining rings if damaged or distorted.*



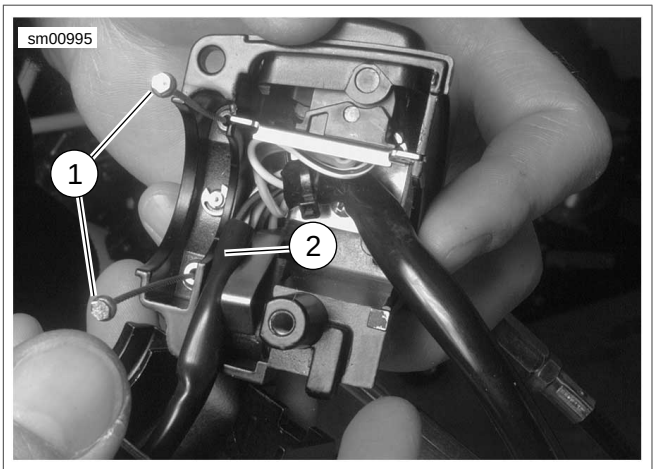

1. **Idle cable insert (gold insert, rear hole)**
2. **Throttle cable insert (silver insert, front hole)**
3. **Tension adjuster screw**

**Figure 8-51. Right Lower Switch Housing**

8. See Figure 8-52. Route the cable to the upper switch housing as shown.
9. Slide the throttle control grip over the end of the right handlebar until it bottoms against the closed end. Rotate the grip so that the ferrule notches are at the top. To prevent binding, pull the grip back about 3.2 mm (1/8 in.).
10. See Figure 8-53. Position lower switch housing beneath the throttle control grip. Install the brass ferrules onto the cable so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches on the throttle control grip. Verify that the cables are captured in the grooves molded into the grip.
11. Position the upper switch housing over the handlebar and lower switch housing.
12. Verify that the wire harness conduit runs in the depression at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
13. Start the upper and lower switch housing screws, but do not tighten.

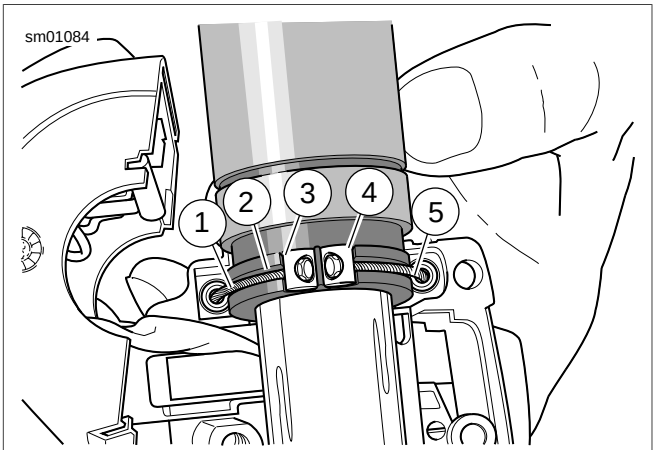
**CAUTION**

**Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)**



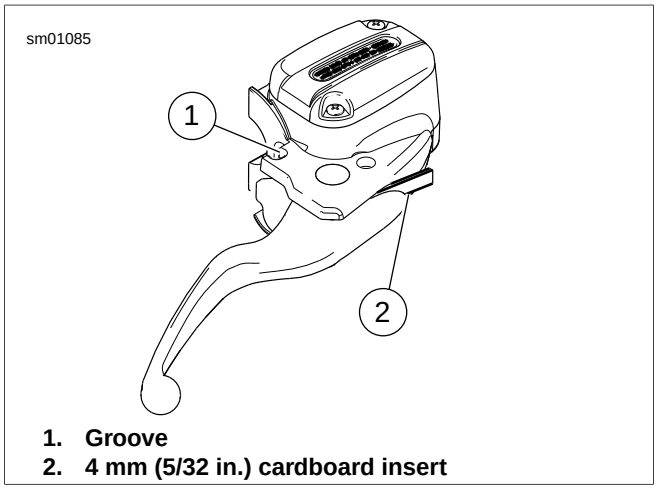

1. **End fittings**
2. **Upper switch housing cable**

**Figure 8-52. Route Cable to Upper Switch Housing**




1. **Throttle cable (silver insert, front hole)**
2. **Groove in throttle grip**
3. **Notch**
4. **Brass ferrule**
5. **Idle cable (gold insert, rear hole)**

**Figure 8-53. Throttle Cable Installation**




1. **Groove**
2. **4 mm (5/32 in.) cardboard insert**

**Figure 8-54. Leave Cardboard Insert in Place**

14. See Figure 8-55. Position the brake lever/master cylinder assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.
15. Align the holes in the handlebar clamp with those in the master cylinder housing and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.
16. Using a T25 TORX drive head, tighten lower and upper switch housing screws to 4.0-5.1 Nm (35-45 **in-lbs**).

*NOTE*

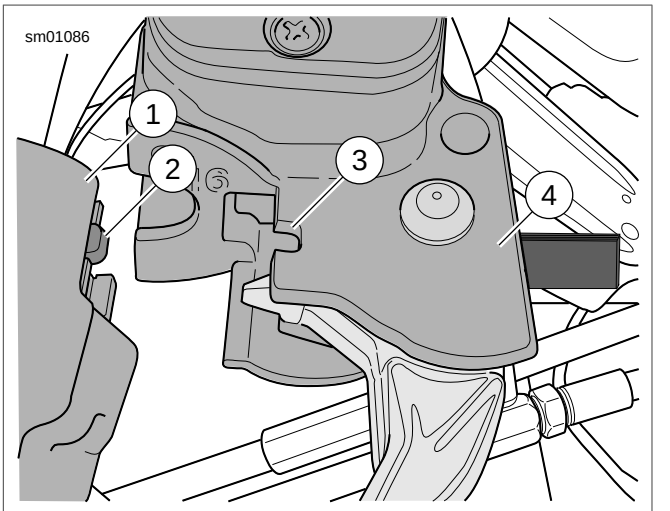
*Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.*

17. Remove the cardboard insert between the brake lever and lever bracket.

**⚠WARNING**

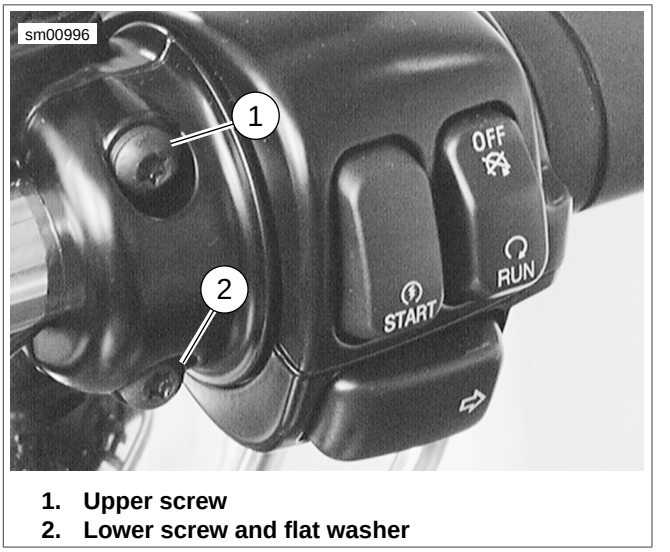
**Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)**

18. Replace the maxi-fuse. Replace the right side cover.
19. Replace the left side cover.
20. Test the switches for proper operation.




1. **Switch housing assembly**
2. **Tab**
3. **Groove**
4. **Brake lever bracket**

**Figure 8-55. Switch Housing Alignment (typical)**




1. **Upper screw**
2. **Lower screw and flat washer**

**Figure 8-56. Handlebar Clamp Screws (typical)**

## DISASSEMBLY

**CAUTION**

**Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)**

1. Place the cardboard insert between the brake lever and lever bracket.
2. Using a T25 TORX drive head, remove the upper and lower switch housing screws.

3. If replacing lower housing switches, perform steps 4 through 7 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
4. See Figure 8-56. Using a T27 TORX drive head, loosen the upper screw (1) securing the handlebar switch clamp to the master cylinder housing. Remove the lower clamp screw with flat washer (2).
5. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
6. Remove the friction shoe from the end of the tension adjuster screw.

*NOTE*

*The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.*

7. Remove the throttle control grip from the end of the handlebar.

## SWITCH REPAIR/REPLACEMENT

### Upper Housing Repair

*NOTE*

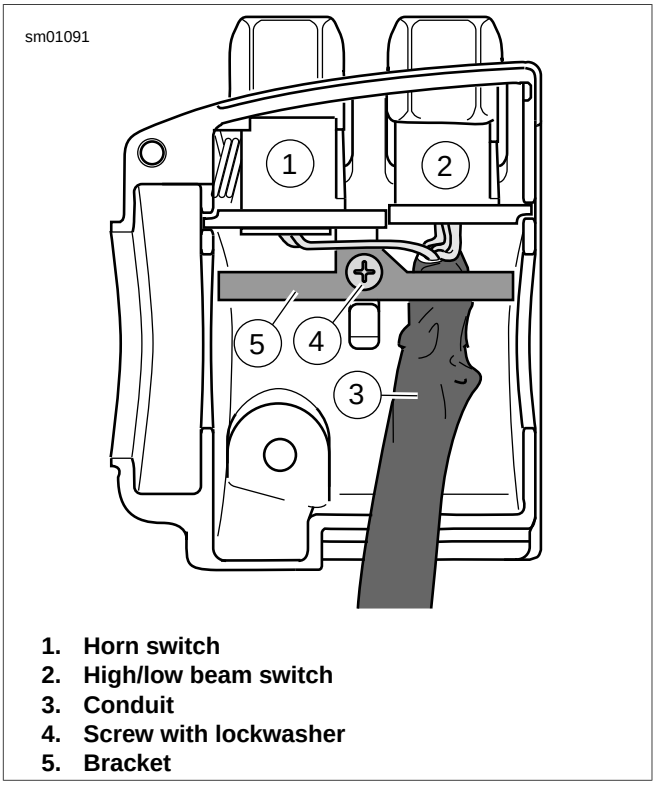
*Replace the engine stop and engine start switches as a single assembly even if only one switch is determined to be faulty.*

1. See Figure 8-57. From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove the bracket and switch assembly from the housing.
2. Move cable conduit (3) from beneath wing of bracket. Cut wires 6.4 mm (0.25 in.) from old switches (1, 2). Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 12.7 mm (0.5 in.) of conduit (3) material. Push conduit back to access switch wires.
4. See Figure 8-58. Separate **new** engine stop switch (2) and engine start switch (1) wires into two bundles.

*NOTE*

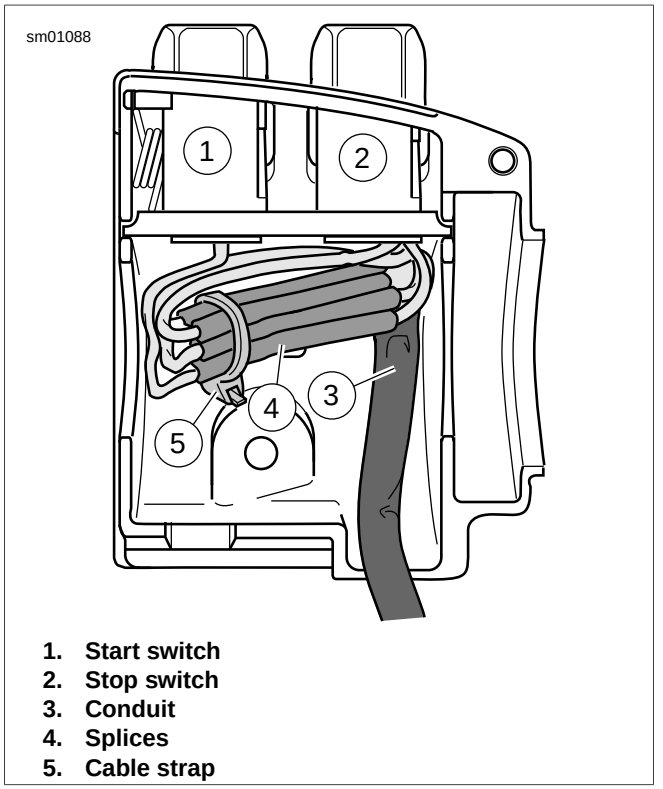
*Replacement stop switch and start switch wires are cut to length, 63.5 mm (2.5 in.) and 50.8 mm (2.0 in.) respectively, and partially stripped.*

5. See 8.23 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 8-58. Route wires downstream of splices beneath wing on engine stop switch side of bracket as shown in Figure 8-57.
7. See Figure 8-58. Install a **new** 177.8 mm (7.0 in.) cable strap (5) beneath wing on engine start switch side (1) of bracket and capture wire splices (4).
8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
9. See Figure 8-57. Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on engine stop switch (2) side of bracket captures edge of conduit (3) as shown.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. Continue with 8.24 RIGHT HANDLEBAR SWITCH, Assembly.




1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Screw with lockwasher**
5. **Bracket**

**Figure 8-57. Upper Housing Without Splices**




1. **Start switch**
2. **Stop switch**
3. **Conduit**
4. **Splices**
5. **Cable strap**

**Figure 8-58. Upper Housing With Splices**

## Lower Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove the screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Continue with TURN-RIGHT SIGNAL SWITCH or FRONT STOPLIGHT SWITCH procedures which follow.

## Turn-Right Signal Switch

1. Perform steps in LOWER HOUSING REPAIR.
2. Cut wire 38.1 mm (1.5 in.) from old switch. Discard old switch assembly.

*NOTE*

*Replacement turn-right signal switch wires are cut to length of 38.1 mm (1.5 in.) and partially stripped.*

3. See 8.23 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
4. Continue with 8.24 RIGHT HANDLEBAR SWITCH, Assembly.

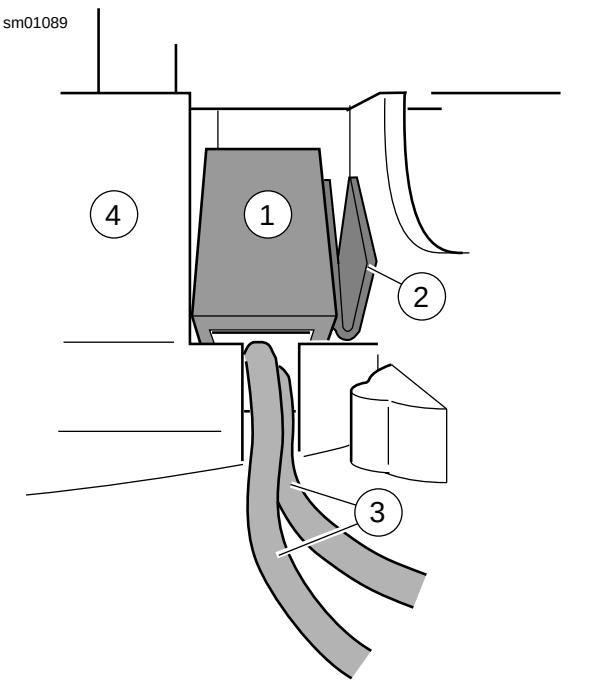
## Front Stoplight Switch

1. Perform steps in LOWER HOUSING REPAIR.
2. Carefully remove the wedge between the switch and switch housing, if present. To remove the switch from the housing, depress the plunger and slowly rotate switch upward while rocking slightly.
3. Cut wires 25.4 mm (1.0 in.) from old switch. Discard old switch.

*NOTE*

*Replacement stoplight switch wires are cut to length of 63.5 mm (2.5 in.) and partially stripped.*

4. See 8.23 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
5. Carefully depress plunger against inside wall of switch housing. With thumb over plunger bore, move switch into the installed position in the switch housing cavity. When plunger is positioned against thumb, slowly rotate switch downward while rocking slightly. Release the plunger only after switch is properly positioned in the cavity.
6. Verify that the plunger is square in the bore and that the boot is not compressed, collapsed or torn. If necessary, gently work the plunger in and out until boot is fully extended.
7. See Figure 8-59. Push down on switch (1) so that it bottoms against housing and wires (3) run in groove at base of cavity. With the concave side facing outward, insert wedge (2) between switch and outboard side of switch housing.
8. Push wedge down until it also bottoms against housing. Verify that the plunger is still square in the bore and then place a drop of RTV Silicone Sealant on upper corner of wedge.
9. Continue with 8.24 RIGHT HANDLEBAR SWITCH, Assembly.




1. **Stoplight switch**
2. **Wedge**
3. **Switch wires**
4. **Lower switch housing**

**Figure 8-59. Install Stoplight Switch**

## ASSEMBLY

1. See Figure 8-60. Insert tapered end of **new** 177.8 mm (7.0 in.) cable strap (1) into round hole in turn signal switch bracket (2) and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

*NOTE*

*Be sure that all splices are positioned above the turn signal switch bracket.*

2. Place the turn signal switch assembly into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.

3. Start screw with lockwasher to secure bracket inside housing.

**CAUTION**

**If routed incorrectly, wires can be pinched by casting or handlebar resulting in switch failure. (00542b)**

4. Loop switch wires so that spliced lengths are positioned across bracket.

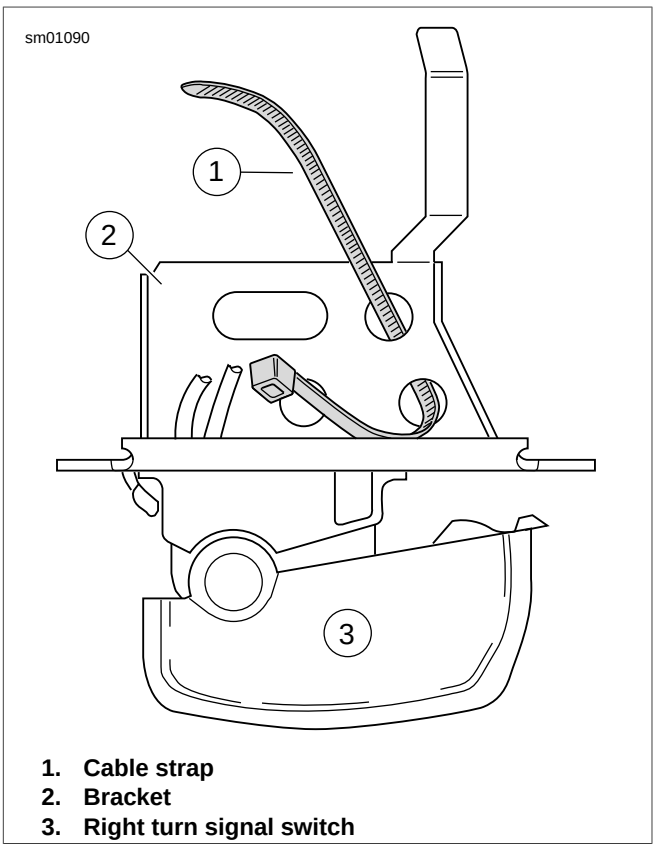
5. Capturing conduit about 6.4 mm (0.25 in.) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.

6. Install second 177.8 mm (7.0 in.) cable strap capturing conduit and wire splices. Securely tighten cable strap to draw splices to conduit. Remove any excess cable strap material.

7. Tighten screw to secure bracket inside housing.

8. Route wire bundle to upper switch housing by gently pressing conduit into channel next to angular arm of bracket. Secure bundle to arm using third cable strap. Cut any excess cable strap material. If necessary, bend angular arm of bracket downward to firmly secure front stoplight switch in position.

9. See 8.24 RIGHT HANDLEBAR SWITCH, Installation.
   a. If lower housing switches were replaced, perform the entire procedure.
   b. If upper housing switches were replaced, begin with step 11.




**1. Cable strap**
**2. Bracket**
**3. Right turn signal switch**

**Figure 8-60. Insert Cable Strap in Switch Bracket**

## REMOVAL

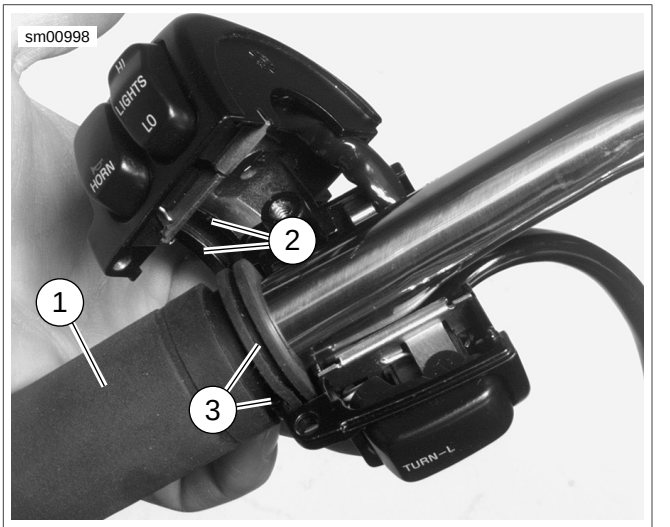
*NOTE*

*The removal and installation steps listed apply when replacing a switch housing and its wire harness. Replacing a switch housing alone, repairing a switch housing, or replacing handlebars will not require removal of the wire harness to the switch housing.*

1. Remove maxi-fuse. See 8.4 MAXI-FUSE.
2. See Figure 8-61. If removing the switch housing and wire harness, remove the left side cover and locate the left switch housing connector [24].
3. Depress the latch on the socket housing and separate the switch housing connector halves.
4. Remove secondary locking wedge and depress terminal latches inside socket housing to remove socket terminals and wires.
5. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the clutch lever and master cylinder bracket. Remove the clutch hand lever assembly and clamp from the handlebar.
6. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
7. Remove the grip sleeve from the end of the handlebar if damaged.
8. To remove the housing with the wire harness, wrap switch housing wires to wire lead and pull wires through opening in upper fork clamp. Leave wire lead in fork clamp.
9. Pull the wire harness through the handlebar clips and remove the housing and wire harness.

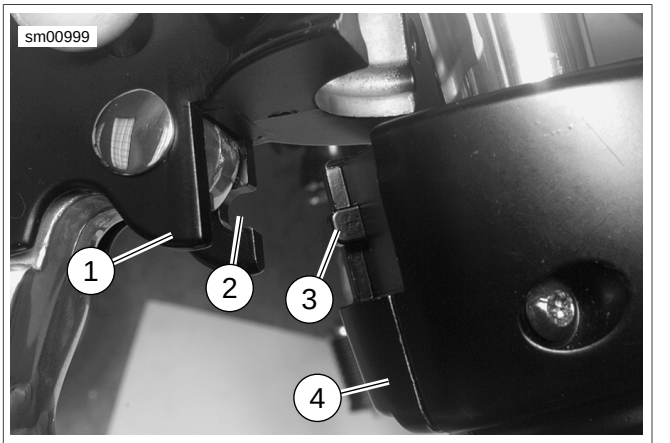



**Figure 8-61. Left Switch Housing Connector [24] (typical)**




1. **Grip sleeve**
2. **Ribs**
3. **Grooves**

**Figure 8-62. Left Handlebar Switch Housings**




1. **Clutch lever bracket**
2. **Groove**
3. **Tab**
4. **Switch housing assembly**

**Figure 8-63. Clutch Lever Bracket**

## INSTALLATION

1. Thread the lose ends of the wire harness through the handlebar clips. Wrap the free ends of the wire harness to the wire lead and pull through the opening in the upper fork clamp.
2. Route wire harness around steering head.
3. Crimp socket terminals on ends of wire and push through connector wire seal and into socket housing.
4. Install internal seal and locking wedge.
5. Mate connector [24] halves.

6. the grip sleeve was removed, thoroughly clean handlebar to remove all adhesive residue. Pour adhesive into **new** grip. Roll grip to evenly distribute adhesive on inside surfaces. Install grip on handlebar with a twisting motion.
7. See Figure 8-62. Install upper and lower switch housings on handlebar. Be sure that ribs (2) on outboard side of switch housings fit in grooves (3) molded into grip.
8. Verify that the wire harness conduit runs in the groove at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
9. Start the upper and lower switch housing screws, but do not tighten.
10. See Figure 8-63. Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab (3) on the lower switch housing in the groove (2) at the bottom of the clutch lever bracket.
11. Align the holes in the handlebar clamp with those in the clutch lever bracket and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten screws to 6.8 Nm (60-80 **in-lbs**) using a T27 TORX drive head.
12. Using a T25 TORX drive head, tighten lower and upper switch housing screws to 4.0-5.1 Nm (35-45 **in-lbs**).

*NOTE*

*Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.*

**⚠WARNING**

**Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)**

13. Replace the maxi-fuse. and the right side cover.
14. Replace the left side cover.
15. Test the switches for proper operation.

## DISASSEMBLY

1. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
2. If replacing lower housing switches, perform next step before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
3. Using a T27 TORX drive head, loosen the upper screw securing the handlebar clamp to the clutch lever bracket. Remove the lower clamp screw with flat washer.

## SWITCH REPAIR/REPLACEMENT

### Upper Housing Repair

*NOTE*

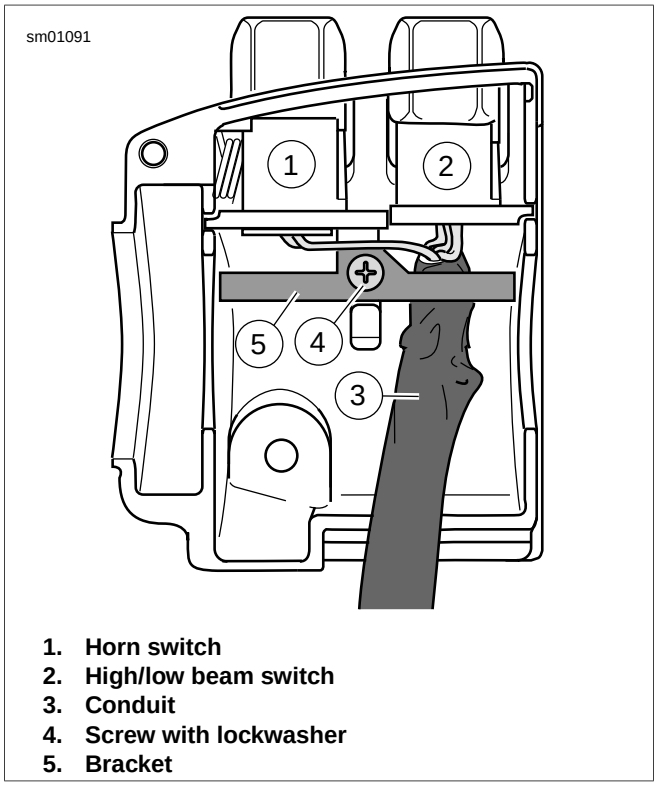
*Replace the horn switch and high/low beam switch as a single assembly even if only one switch is determined to be faulty.*

1. See Figure 8-64. From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove bracket and switch assembly from the housing.
2. Move cable conduit (3) from beneath wing of bracket. Cut wires 6.4 mm (0.25 in. ) from old switches (1, 2). Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 12.7 mm (0.5 in.) of conduit (3) material. Push conduit back to access switch wires.
4. Separate the **new** horn switch (1) and high/low beam switch (2) wires into two bundles.

*NOTE*

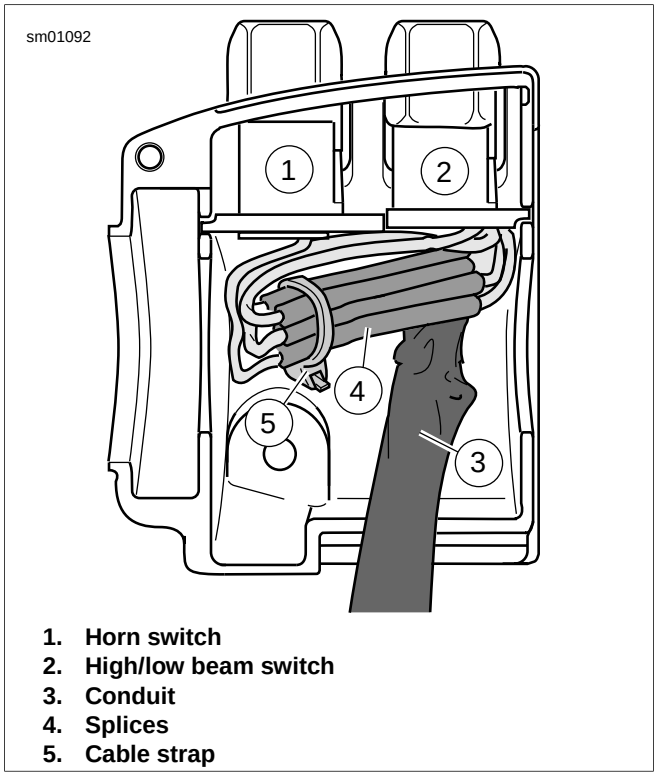
*Replacement high/low beam switch and horn switch wires are cut to length of 63.5 mm (2.5 in.) and 50.8 mm (2.0 in.) respectively, and partially stripped.*

5. See 8.23 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 8-65. Route wires downstream of splices beneath wing on high/low beam switch side of bracket as shown in Figure 8-64.
7. See Figure 8-65. Install a **new** 177.8 mm (7.0 in.) cable strap (5) beneath wing on horn switch side (1) of bracket and capture wire splices (4).
8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
9. See Figure 8-64. Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on high/low switch (2) side of bracket captures edge of conduit (3) as shown.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. Continue with 8.25 LEFT HANDLEBAR SWITCH, Assembly.




1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Screw with lockwasher**
5. **Bracket**

**Figure 8-64. Upper Housing Without Splices**




1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Splices**
5. **Cable strap**

**Figure 8-65. Upper Housing With Splices**

## Lower Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Continue with TURN-LEFT SIGNAL SWITCH or CLUTCH INTERLOCK SWITCH procedures.

## Turn-Left Signal Switch

1. Perform steps in LOWER HOUSING REPAIR.
2. Cut wires 38.1 mm (1.5 in.) from old switch (Turn-L(eft) Signal Switch). Discard switch assembly.

*NOTE*

*Replacement turn-right signal switch wires are cut to length of 38.1 mm (1.5 in.) and partially stripped.*

3. See 8.23 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
4. Continue with 8.25 LEFT HANDLEBAR SWITCH, Assembly.

## Clutch Interlock Switch

1. Perform steps in LOWER HOUSING REPAIR.
2. See Figure 8-66. Cut wires 6.4 mm (0.25 in.) from old switch. Discard switch assembly.

*NOTE*

*Replacement turn-right signal switch wires are cut to length and partially stripped.*

3. See 8.23 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
4. Continue with 8.25 LEFT HANDLEBAR SWITCH, Assembly.

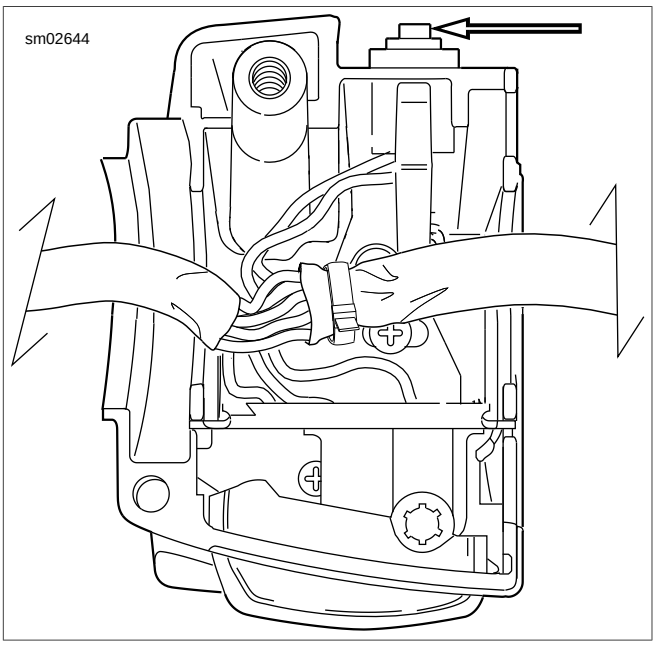



**Figure 8-66. Clutch Interlock Switch**

## ASSEMBLY

1. See Figure 8-67. Insert tapered end of **new** 177.8 mm (7.0 in.) cable strap (1) into round hole in turn signal switch

bracket (2) and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

*NOTE*

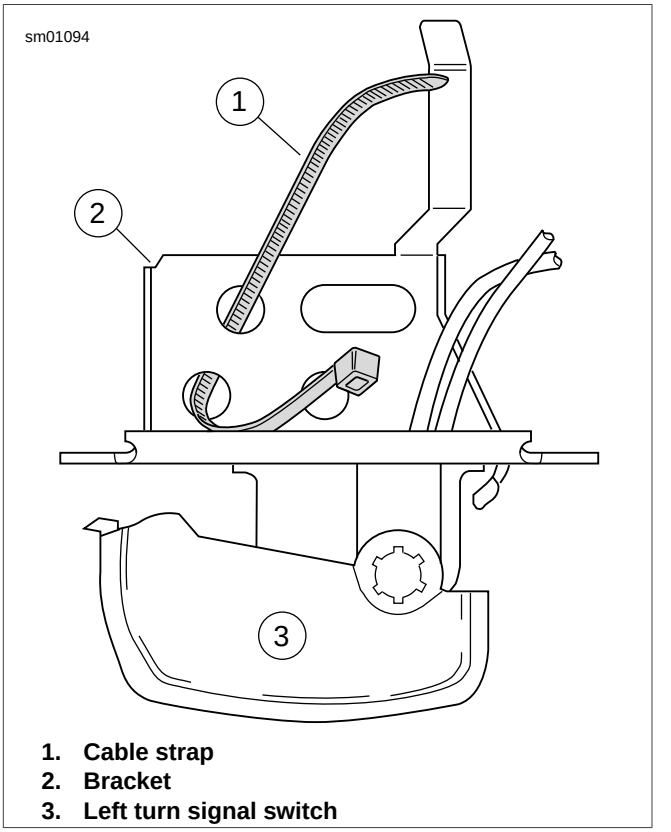
*Be sure that all splices are positioned above the turn signal switch bracket.*

2. Place the turn signal switch assembly (3) into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.
3. Start screw with lockwasher to secure bracket inside housing.

**CAUTION**

**If routed incorrectly, wires can be pinched by casting or handlebar resulting in switch failure. (00542b)**

4. Loop switch wires so that spliced lengths are positioned across bracket.
5. Capturing conduit about 6.4 mm (0.25 in.) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Tighten screw to secure bracket inside housing.
7. Route wire bundle to upper switch housing below and then forward of the main wire harness, positioning conduit in channel next to angular arm of bracket. Secure bundle to arm using new cable strap. Cut any excess cable strap material.
8. See 8.25 LEFT HANDLEBAR SWITCH, Installation.
   a. If lower housing switches were replaced, perform the whole procedure.
   b. If upper housing switches were replaced, begin with step 7.
9. Verify the operation of the clutch interlock switch. See the ELECTRICAL DIAGNOSTIC MANUAL.




1. **Cable strap**
2. **Bracket**
3. **Left turn signal switch**

**Figure 8-67. Insert Cable Strap in Switch Bracket**

# NOTES

**SUBJECT** **PAGE NO.**

A.1 AMP 1-PLACE CONNECTORS....A-1
A.2 AMP MULTILOCK CONNECTORS....A-3
A.3 AUTOFUSE ELECTRICAL CONNECTOR....A-7
A.4 DELPHI CONNECTORS....A-8
A.5 DELPHI MAXI-FUSE HOUSING....A-10
A.6 DEUTSCH 1-PLACE ELECTRICAL CONNECTORS....A-12
A.7 DEUSCH ELECTRICAL CONNECTORS....A-13
A.8 DEUTSCH MINI-TERMINAL CRIMPS....A-17
A.9 DEUTSCH STANDARD TERMINALS....A-18
A.10 DEUTSCH SOLID BARREL TERMINALS....A-19
A.11 MOLEX CONNECTORS....A-21
A.12 PACKARD 150 METRI-PACK CONNECTORS....A-25
A.13 PACKARD 280 METRI-PACK RELAY AND FUSE BLOCK CONNECTORS....A-27
A.14 PACKARD 480 METRI-PACK CONNECTORS....A-28
A.15 PACKARD 630 METRI-PACK CONNECTORS....A-29
A.16 PACKARD METRI-PACK TERMINALS....A-30
A.17 PACKARD ECM CONNECTOR....A-32
A.18 PACKARD MICRO-64 CONNECTORS....A-34
A.19 SEALED SPLICE CONNECTORS....A-37

# NOTES

## AMP 1-PLACE CONNECTOR REPAIR

| PART NUMBER | TOOL NAME |
|---|---|
| HD-38125-7 | PACKARD TERMINAL CRIMPER |
| HD-39621-27 | SOCKET TERMINAL TOOL |
| HD-39621-28 | PIN TERMINAL REMOVER |

### General

Obtain the necessary tools to repair the connector or terminals.

For terminal crimping, use the PACKARD TERMINAL CRIMPER (Part No. HD-38125-7).

### Separating Pin and Socket Housings

Bend back the ears on the pin housing slightly and separate the pin and socket halves of the connector.

### Mating Pin and Socket Housings

Push the pin and socket halves of the connector together until the latches click.

### Removing Socket Terminals

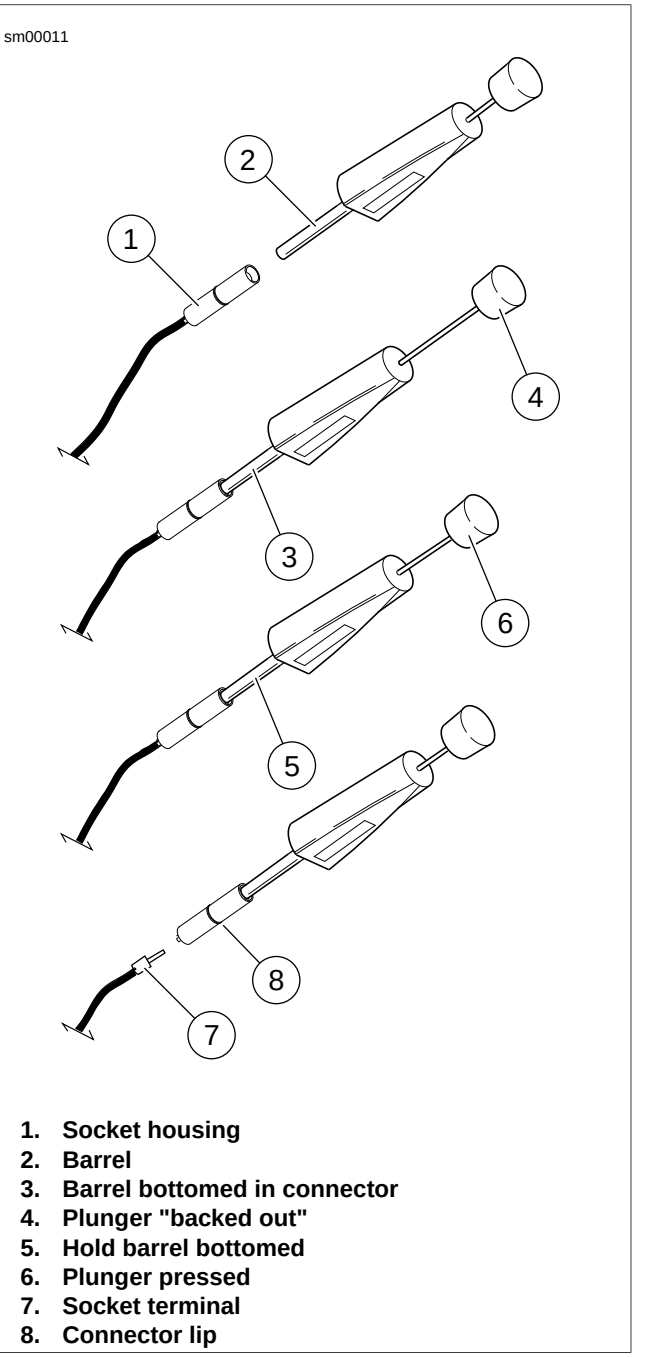
1. See Figure A-1. Grasp the lead on the wire end of the socket housing (1) and push the terminal forward toward the mating end of the connector until it stops. This will disengage the locking tang from the groove in the connector.
2. Fit the barrel (2) of the SOCKET TERMINAL TOOL (Part No. HD-39621-27) over the socket.
3. While rotating the tool slightly, push until it bottoms (3) in the socket housing.
4. Allow the plunger (4) to "back out" of the handle.
5. Holding the socket housing while keeping the tool firmly bottomed (5), depress the plunger (6). The terminal (7) pops out the wire end of the connector.

*NOTE*

*If the terminal is not released from the socket housing, then the terminal was not pushed forward far enough before placement of the tool or the tool was not bottomed in the connector housing.*

### Installing Socket Terminal

1. Note the lip at the middle of the socket housing. One side of the lip is flat while the other side is tapered. Insert the wire terminal into the socket housing on the flat (lip) side.
2. Push the lead into the socket housing until it stops. A click is heard when the terminal is properly seated.
3. Gently tug on the lead to verify that the terminal is locked in place.




1. **Socket housing**
2. **Barrel**
3. **Barrel bottomed in connector**
4. **Plunger "backed out"**
5. **Hold barrel bottomed**
6. **Plunger pressed**
7. **Socket terminal**
8. **Connector lip**

**Figure A-1. Socket Terminal Tool (HD-39621-27)**

### Removing Pin Terminal

1. Grasp the lead on the wire end of the pin housing and push the terminal forward toward the mating end of the connector until it stops. This will disengage the locking tang from the groove in the connector.

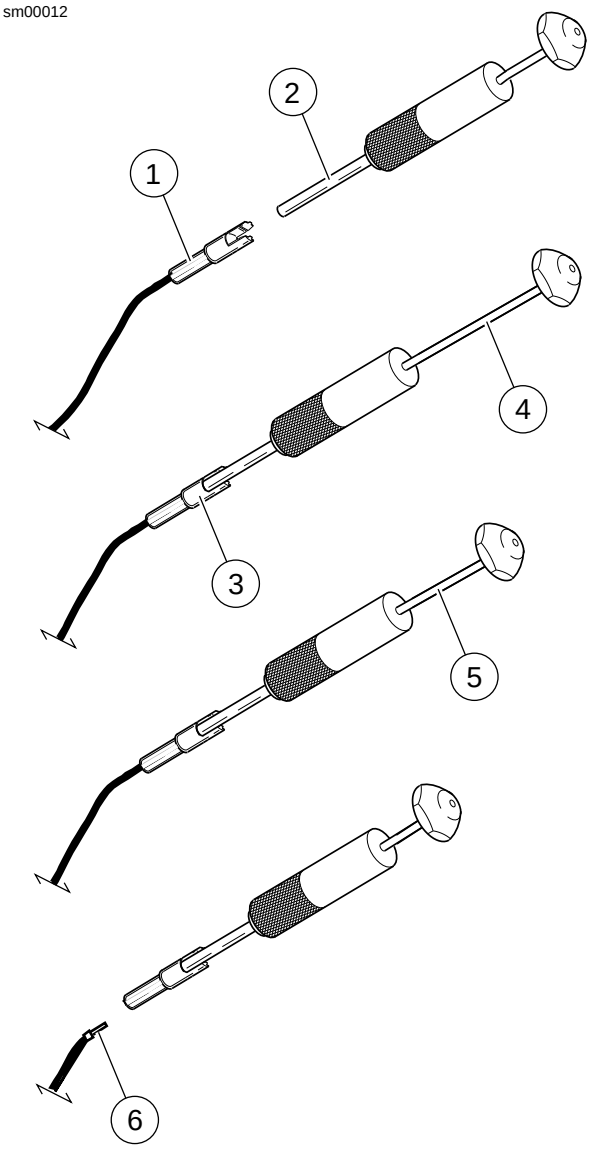
2. See Figure A-2.
   a. Fit the barrel of the PIN TERMINAL REMOVER (Part No. HD-39621-28) over the pin, and while rotating the tool slightly, push until it bottoms in the housing. Allow the plunger to "back out" of the handle.
   b. Holding the pin housing while keeping the tool firmly bottomed, depress the plunger. The terminal pops out the wire end of the connector.

*NOTE*

*If the terminal is not released from the pin housing, then the terminal was not pushed forward far enough before placement of the tool or the tool was not bottomed in the connector housing.*

## Installing Pin Terminal

1. Push the lead into the pin housing until it stops. A click is heard when the terminal is properly seated.
2. Gently tug on the lead to verify that the terminal is locked in place.




1. **Pin housing**
2. **Barrel**
3. **Barrel bottomed in connector**
4. **Plunger backed out of the handle**
5. **Depressed plunger**
6. **Pin terminal**

**Figure A-2. AMP Pin Terminal Remover (HD-39621-28)**

## AMP MULTILOCK CONNECTOR REPAIR

| PART NUMBER | TOOL NAME |
|---|---|
| HD-41609 | AMP MULTILOCK CRIMPER |

### General

AMP Multilock connectors are found between wire harnesses and component wiring and may be either floating or anchored to the frame with attachment clips.

See Figure A-3. Attachment clips (1) on the pin housings are fitted to T-studs on the motorcycle frame. The T-studs identify OE connector locations. To maintain serviceability, always return connectors to OE locations after service.

Obtain the necessary tools to repair the connector and terminals.

*NOTE*

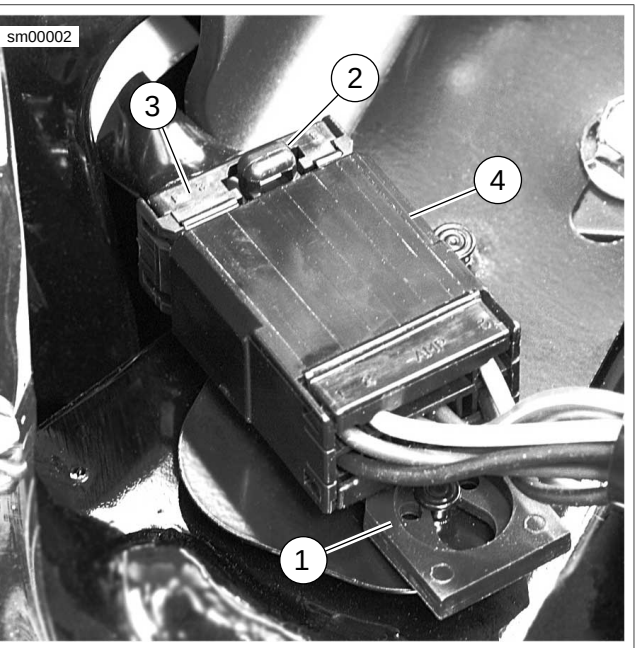
*For terminal crimping use the AMP MULTILOCK CRIMPER (Part No. HD-41609).*

### Separating Pin and Socket Housings

1. If necessary, slide connector attachment clip T-stud to the large end of the opening.
2. See Figure A-3. Depress the release button (2) on the socket terminal side of the connector and pull the socket housing (3) out of the pin housing (4).

### Mating Pin and Socket Housings

1. Hold the housings to match wire color to wire color.
2. Insert the socket housing into the pin housing until it snaps in place.
3. If OE location is a T-stud, fit large opening end of attachment clip over T-stud and slide connector to engage T-stud to small end of opening.




1. **Attachment clip**
2. **Release button**
3. **Socket housing**
4. **Pin housing**

**Figure A-3. AMP Multilock Connector**

### Removing Terminals from Housing

1. See Figure A-4. Bend back the latch (1) to free one end of secondary lock (2) then repeat on the opposite end. Hinge the secondary lock outward.
2. Look in the terminal side of the connector (opposite the secondary lock) and note the cavity next to each terminal.
3. Insert a pick or pin into the terminal cavity until it stops.

*NOTE*

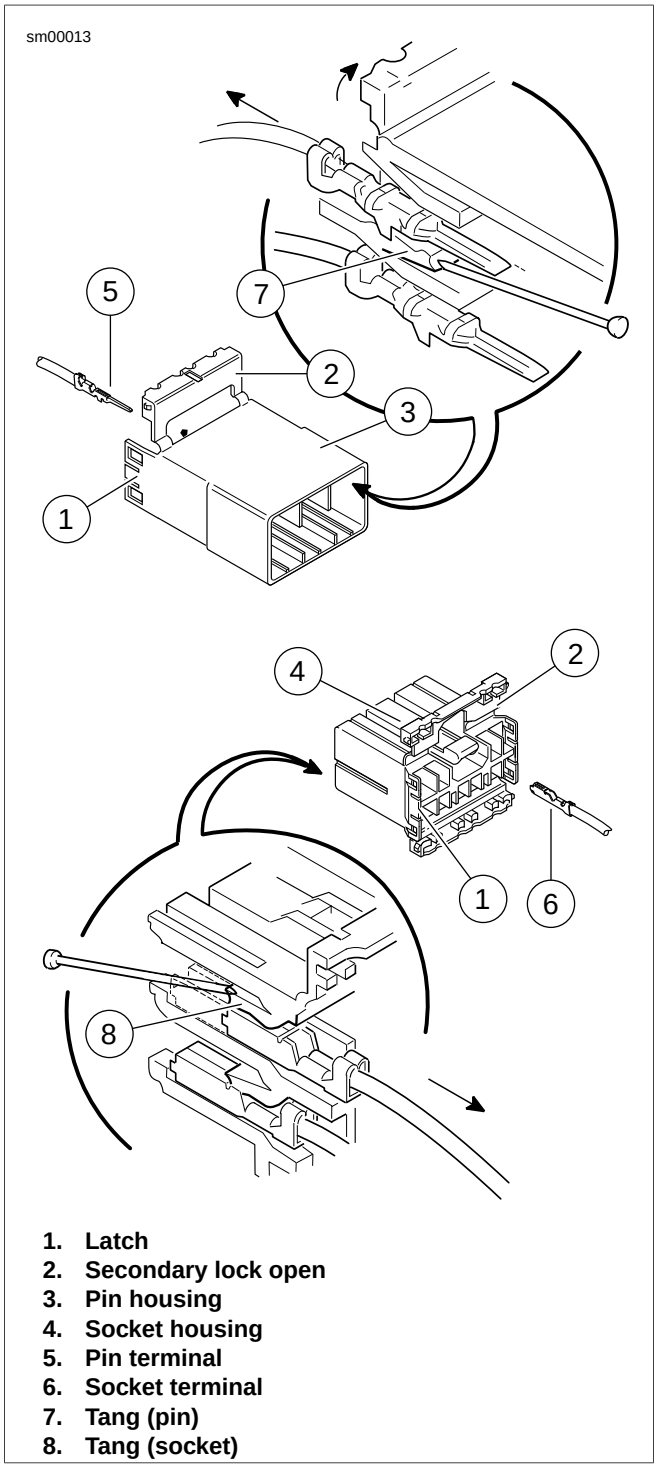
*If socket/pin terminal tool is not available, a push pin/safety pin or a Snap-on pick (Part No. TT600-3) may be used.*

4. Press the tang in the housing to release the terminal.
   a. **Socket:** Lift the socket tang (8) up.
   b. **Pin:** Press the pin tang (7) down.

*NOTE*

*A "click" is heard if the tang is released.*

5. Gently tug on wire to pull wire and terminal from cavity.




1. **Latch**
2. **Secondary lock open**
3. **Pin housing**
4. **Socket housing**
5. **Pin terminal**
6. **Socket terminal**
7. **Tang (pin)**
8. **Tang (socket)**

**Figure A-4. AMP Multilock Connector: Socket and Pin Housings**

## Inserting Terminals into Housing

*NOTE*

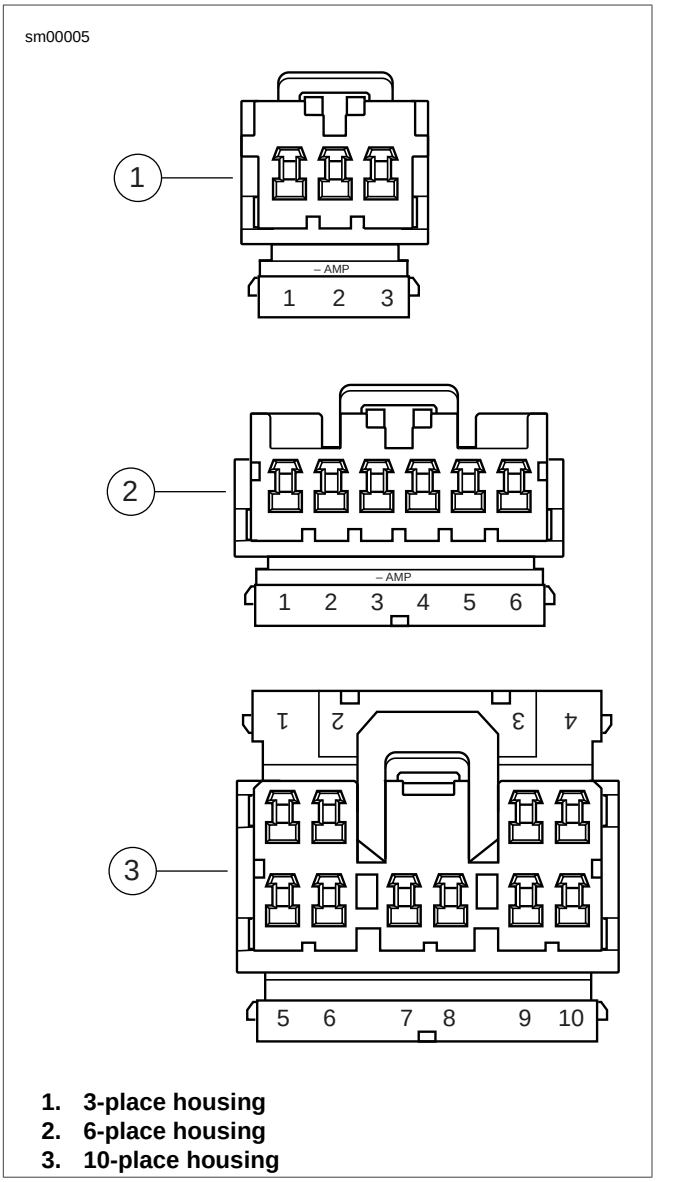
*See Figure A-5. Cavity numbers are stamped into the secondary locks of both the socket and pin housings. Match the wire color to the cavity number found on the wiring diagram.*

1. Hold the terminal so the catch faces the tang in the chamber. Insert the terminal into its numbered cavity until it snaps in place.

*NOTES*

- *Up and down can be determined by the position of the release button, the button is the top of the connector.*
- *On the pin side of the connector, tangs are positioned at the bottom of each cavity, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.*
- *On the socket side, tangs are at the top of each cavity, so the socket terminal slot (on the same side as the crimp tails) must face upward.*

2. Gently tug on wire end to verify that the terminal is locked in place.
3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.




1. **3-place housing**
2. **6-place housing**
3. **10-place housing**

**Figure A-5. AMP Multilock Connector: Cavity Numbers on Secondary Locks (Socket Housings Shown)**

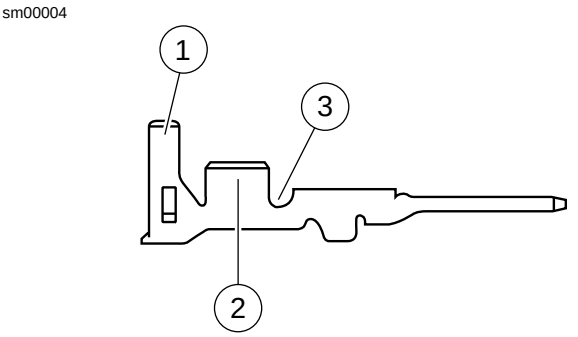
## Preparing Wire Leads for Crimping

1. Strip 4.0 mm (5/32 in.) of insulation from the wire lead.

2. See Figure A-4 and Figure A-7. Select the pin/socket terminals from the parts catalog and identify the insulation crimp tails (1) and the wire crimp tails (2) and the groove for the crimp tool locking bar (3).
3. Identify the wire lead gauge and the corresponding crimper tool and nesting die. Refer to Table A-1.

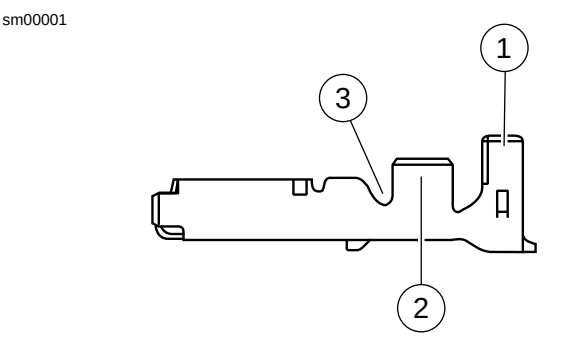
**Table A-1. AMP Multilock Connector: Crimp Tool Wire Gauge/Nest**

| WIRE GAUGE | NEST |
|---|---|
| 20 | Front |
| 16 | Middle |
| 18 | Rear |




1. **Insulation crimp tail**
2. **Wire crimp tail**
3. **Locking bar groove**

**Figure A-6. AMP Multilock Connector: Pin Terminal**




1. **Insulation crimp tail**
2. **Wire crimp tail**
3. **Locking bar groove**

**Figure A-7. AMP Multilock Connector: Socket Terminal**

## Crimping Terminals to Leads

*NOTE*

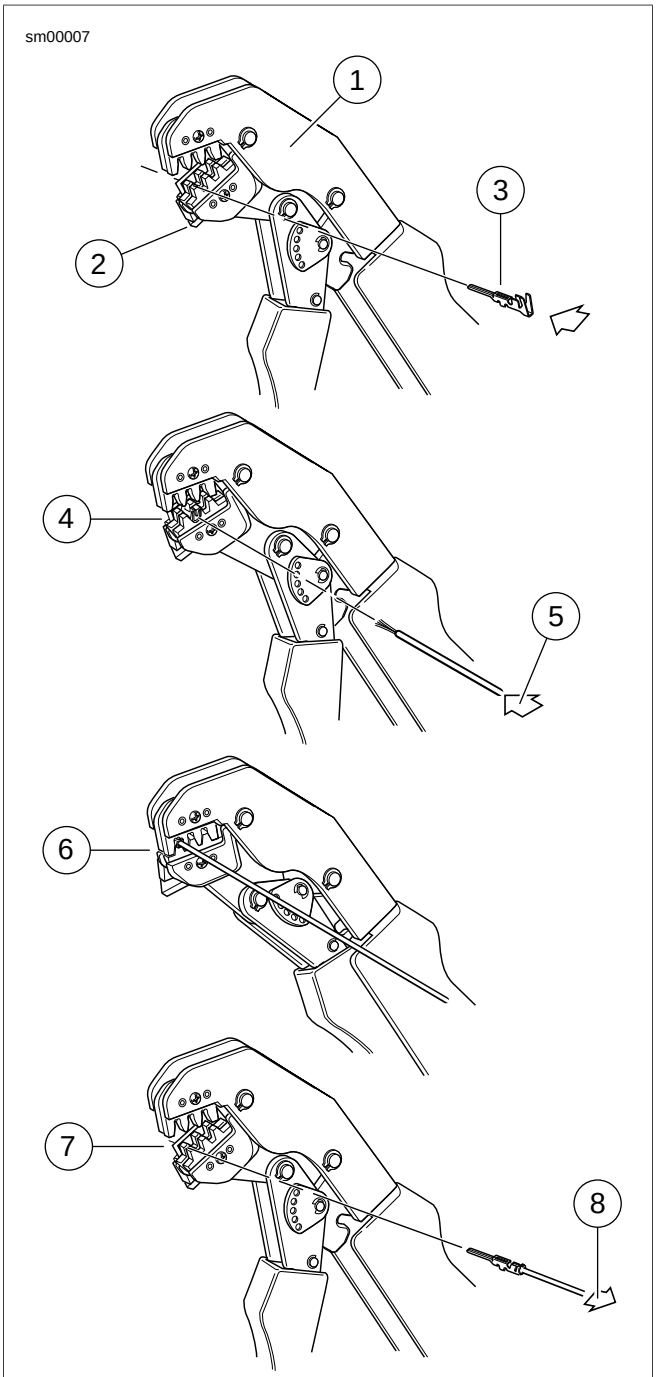
*Crimping with an Amp Multilock tool is a one step operation. One squeeze crimps both the wire core and the insulation tails.*

1. See Figure A-8. Squeeze the handles to cycle the AMP MULTILOCK CRIMPER (Part No. HD-41609) to the fully open position (1).
2. Raise locking bar by pushing up on bottom flange (2).

*NOTE*

*See Figure A-4 and Figure A-7. Hold the terminal with the insulation crimp tail (1) facing up. The tool will hold the terminal by the locking bar groove (3) and crimp the wire crimp tail (2) around the bare wire of the stripped lead and the insulation crimp tail around the insulation.*

3. See Figure A-8. With the insulation crimp tail facing upward, insert terminal (pin or socket) (3) through the locking bar, so that the closed side of the terminal rests on the nest of the crimp tool.
4. Release locking bar to lock position of contact (4). When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
5. Insert stripped end of lead (5) until ends make contact with locking bar.
6. Verify that wire is positioned so that wire crimp tails squeeze bare wire strands, while insulation crimp tails fold over the wire lead insulation.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Raise up locking bar (8) and remove crimped terminal.

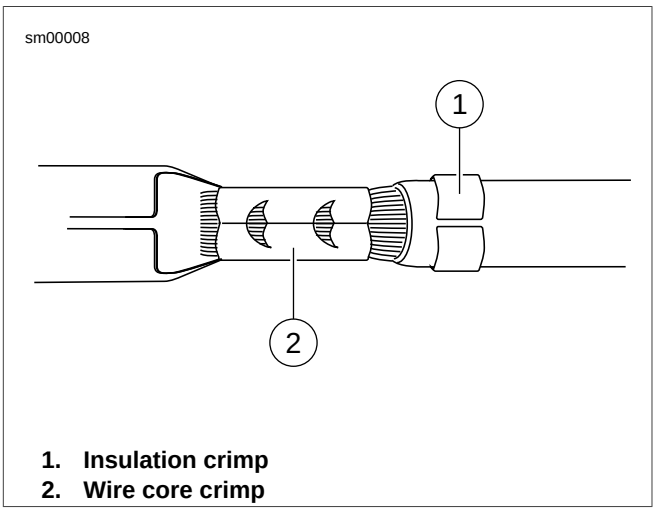



1. **Open position**
2. **Locking bar flange**
3. **Insert contact**
4. **Release locking bar**
5. **Insert lead**
6. **Squeeze**
7. **Raise locking bar**
8. **Remove crimped terminal**

**Figure A-8. AMP Multilock Connector: Terminal Crimping Procedure**

## Inspecting Crimped Terminals

See Figure A-9. Inspect the wire core crimp (2) and insulation crimp (1). Distortion should be minimal.




1. **Insulation crimp**
2. **Wire core crimp**

**Figure A-9. AMP Multilock Connector: Terminal Crimp**

## GENERAL

Autofuse electrical terminals are found in ignition switches and fuse blocks.

## AUTOFUSE CONNECTOR REPAIR

| PART NUMBER | TOOL NAME |
|---|---|
| GA500A | SNAP-ON TERMINAL PICK |

### General

Autofuse electrical connector terminals are found in ignition switches and some fuse blocks.

### Disassembly

1. Obtain SNAP-ON TERMINAL PICK (Part No. GA500A).
2. See Figure A-10 or Figure A-11. Insert smallest pair of pins into chamber on mating end of socket housing to depress tangs on each side of terminal simultaneously.
3. Gently pull on wire to remove terminal from wire end of socket housing.
4. If necessary, crimp **new** terminals on wires.

### Assembly

1. Using a thin flat blade, like that on a hobby knife, carefully bend tang on each side of terminal outward away from terminal body.
2. With the open side of the terminal facing rib on wire end of socket housing, insert terminal into chamber until it locks in place.

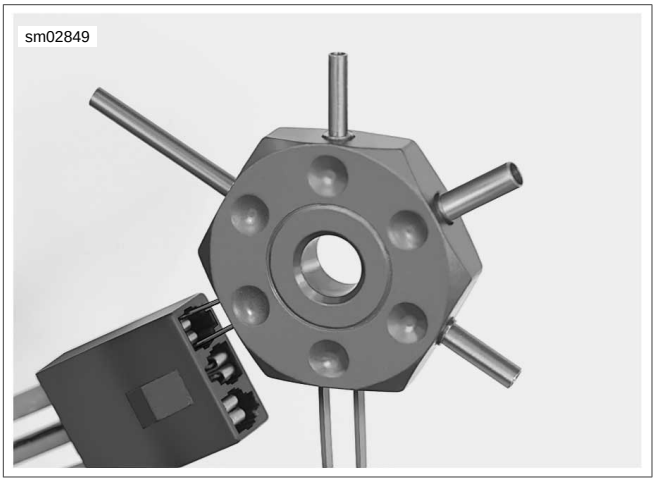



**Figure A-10. Removing Autofuse Terminal from Ignition Switch**

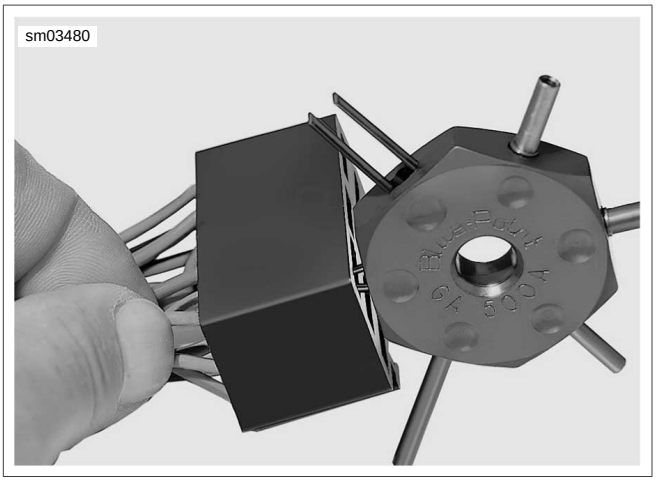



**Figure A-11. Removing Autofuse Terminal from Fuse Block**

## ASSEMBLY

1. Using a thin flat blade, like that on an X-Acto knife, carefully bend tang on each side of terminal outward away from terminal body.
2. With the open side of the terminal facing rib on wire end of socket housing, insert terminal into chamber until it locks in place.

## DELPHI CONNECTOR REPAIR

### General

Delphi connectors are embossed with the brand name, Delphi, on the housing latch.

### Separating Pin and Socket Housings

See Figure A-12. Bend back the external latch(es) slightly and separate pin and socket halves of connector.

### Mating Pin and Socket Housings

Push pin and socket halves of connector together until external latch(es) engage.

### Removing Socket Terminals

*NOTE*

*Although the parts of the different Delphi connectors vary in appearance, the instructions which follow will work for all. The only exception is the oil pressure sender connector [139B], the terminals of which are removed like the Packard push-to-seat connectors. Therefore, see A.12 PACKARD 150 METRI-PACK CONNECTORS to remove/install terminals in this connector.*

1. See Figure A-13. If present, free one side of wire lock (1) from ear on wire end of socket housing, then release the other side. Release wires from channels in wire lock and remove from socket housing.
2. Use a fingernail to pry colored terminal lock (2) loose and then remove from mating end of socket housing.
3. Using a thin flat blade, like the unsharpened edge of a hobby knife, gently pry tang (3) outward away from terminal, and then tug on wire to back terminal out wire end of chamber. Do not pull on wire until tang is released or terminal will be difficult to remove.

### Installing Socket Terminals

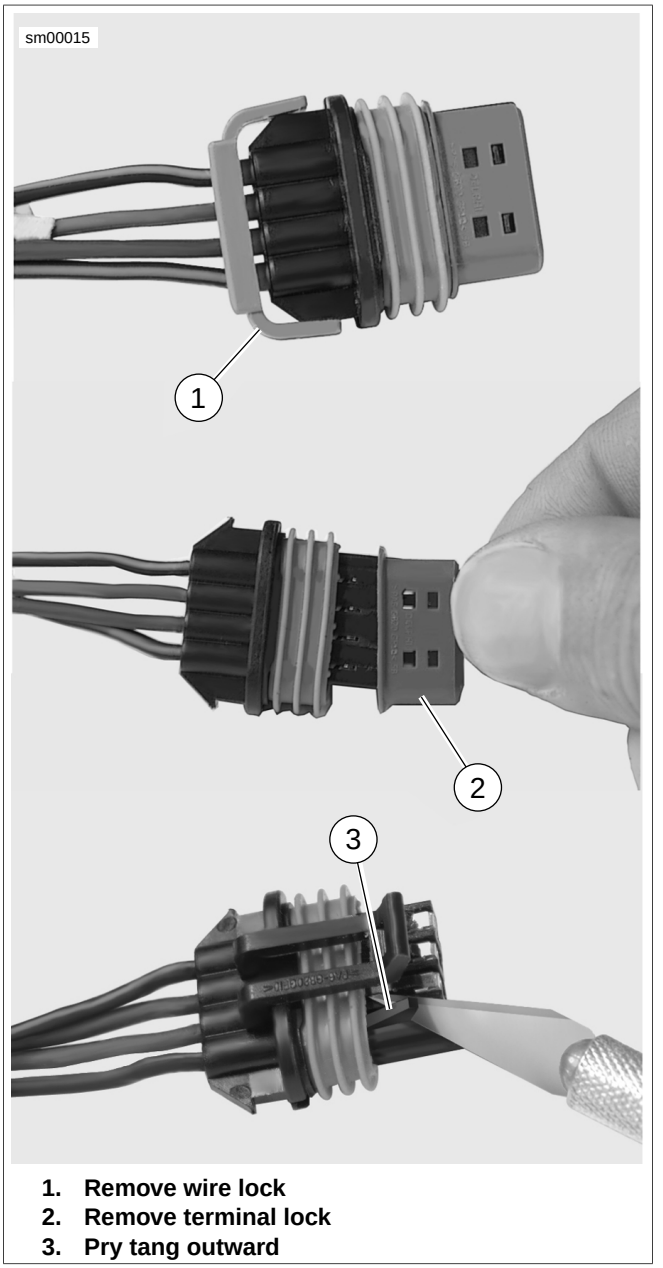
*NOTE*

*For wire location purposes, alpha or numeric characters are stamped into the wire end of each socket housing.*

1. Gently push tang on socket housing inward toward chamber. With the open side of the terminal facing the tang, push terminal into chamber at wire end of socket housing.
2. Gently tug on wire to verify that terminal is locked and will not back out of chamber. If necessary, use fingernail to push tang into engagement with terminal.
3. Install colored terminal lock onto mating end of socket housing.
4. If present, seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.




**Figure A-12. Delphi Connector: Socket Housing Latch**




1. **Remove wire lock**
2. **Remove terminal lock**
3. **Pry tang outward**

**Figure A-13. Delphi Connector: Removing Socket Terminals**

## DELPHI MAXI-FUSE HOUSING REPAIR

### General

A Delphi Maxi-fuse connector completes the circuit through the main fuse (Maxi-fuse).

### Removing Maxi-Fuse

1. See Figure A-14. Depress latches on Maxi-fuse cover (1) and then slide cover off of connector (2).
2. Holding the connector (fuse holder), pull the Maxi-fuse out of the connector.

### Installing Maxi-Fuse

1. Insert the blade terminals of the Maxi-fuse into the sockets of the connector and press the Maxi-fuse into the connector.
2. Slide the cover over the fuse until the cover clicks into place.

*NOTE*

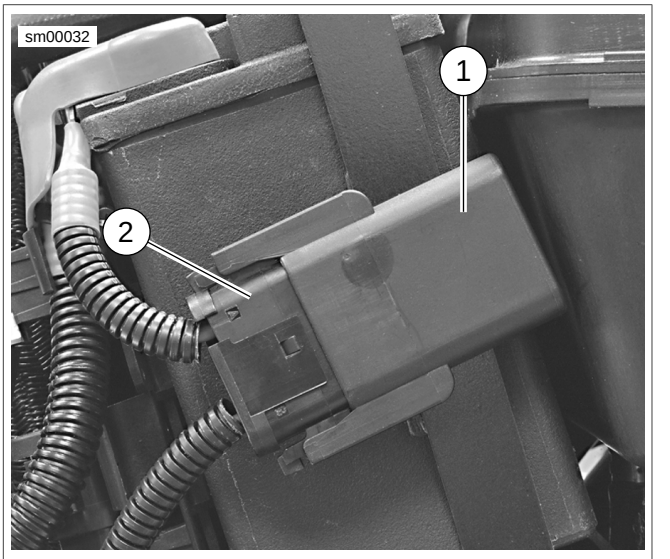
*If removed from an OE attachment such as a grooved fuse block cover, engage cover and slide into place.*

### Removing Socket Terminals

1. See Figure A-15. Gently pull socket housing to disengage slots (1) on secondary lock (2) from tabs (3) on socket housing. Free secondary lock from cables and set aside.
2. Take note of the opening on one side of the socket terminal. Gently insert flat blade of pick (Snap-On TT600-5) or small screwdriver into opening (4) until it stops. Pivot the pick toward the terminal body and hold in position.
3. Tug on cable to pull socket from wire end of socket housing. A firm tug is necessary to overcome the resistance of the rubber seal.
4. Repeat to remove remaining socket terminal.

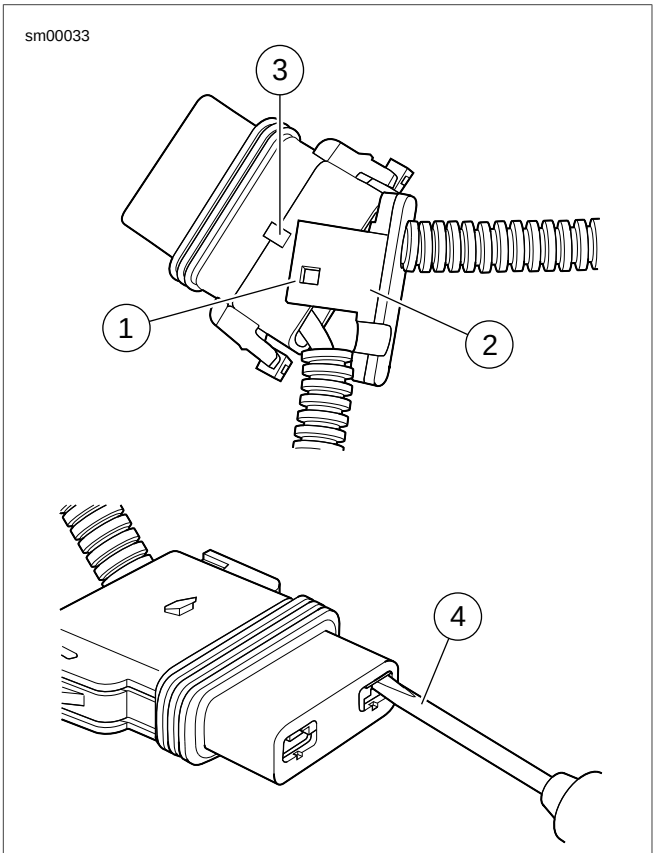
### Installing Socket Terminals

1. See Figure A-16. Carefully bend tang outward away from the terminal body.
2. Feed socket into wire end of socket housing until it clicks in place. Verify that socket will not back out of chamber. A slight tug on the cable will confirm that it is locked.
3. Push rubber seal into wire end of socket housing.
4. Repeat to install remaining socket terminal.
5. Install secondary lock onto cables and then push onto wire end of socket housing until slots engage tabs on sides of socket housing.




1. **Maxi-fuse cover**
2. **Delphi Maxi-fuse housing**

**Figure A-14. Delphi Connector Housing: Maxi-Fuse**




1. **Secondary lock slot**
2. **Secondary lock**
3. **Tab**
4. **Insert flat blade into opening**

**Figure A-15. Delphi Maxi-Fuse Housing: Remove Socket Terminals**

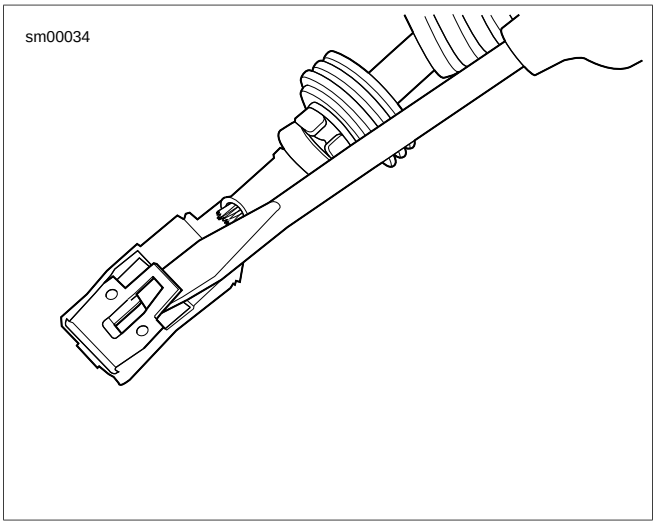



**Figure A-16. Delphi Maxi-Fuse Housing: Bend Tang**

## DEUTSCH 1-PLACE CONNECTOR REPAIR

### Separating Pin and Socket Housings

Depress external latch and separate the pin and socket housings of the Deutsch one place connector found on voltage regulators.

### Mating Pin and Socket Housings

Orient the housings so the latch faces the catch and push the housings together until it clicks.

### Removing Socket Terminals

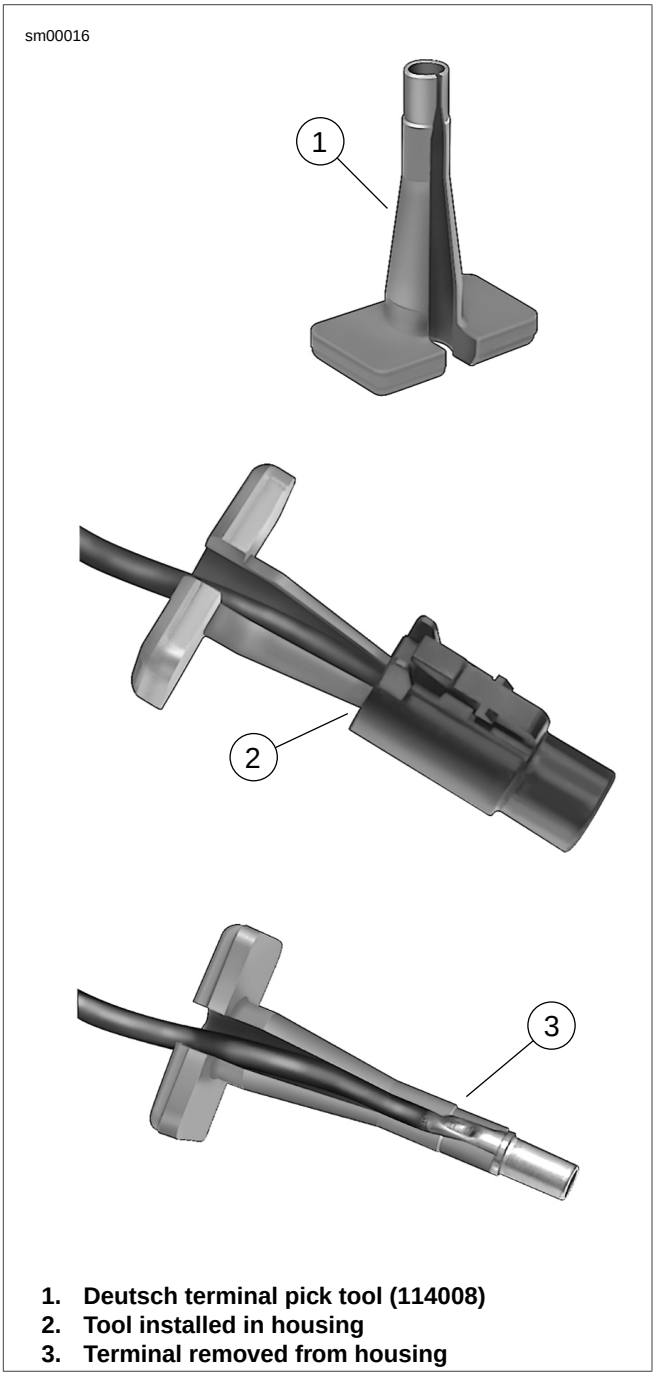
*NOTE*

*Rough handling or careless storage can result in tool damage. Exercise care to avoid cracking or breaking the thin plastic construction.*

1. Pull rear wire seal from back of housing and slide down voltage regulator cable to move out of the way.
2. See Figure A-17. Using terminal pick tool (Deutsch® 114008) (1), install tool onto voltage regulator cable so that the tapered end is in the wire end of the housing (2).
3. Push tool into wire end of housing until it bottoms. Gently tug on housing to pull from terminal (3).
4. Remove tool from voltage regulator cable.

### Installing Socket Terminals

1. Insert terminal into wire end of housing until it "clicks" in place. Verify that terminal will not back out of housing. A slight tug on the voltage regulator cable will confirm that it is properly locked in place.
2. Fit rear wire seal into back of housing.




**1. Deutsch terminal pick tool (114008)**
**2. Tool installed in housing**
**3. Terminal removed from housing**

**Figure A-17. Deutsch 1-Place Connector: Remove Socket/Pin Housing**

## DEUTSCH CONNECTOR REPAIR

| PART NUMBER | TOOL NAME |
|---|---|
| HD-41475 | DEUTSCH CONNECTOR SERVICE KIT |
| HD-41475-100 | FLAT BLADE L-HOOK |

### General

Deutsch connectors are colored coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are **black**.

*NOTE*

*A DEUTSCH CONNECTOR SERVICE KIT (Part No. HD-41475) contains a selection of wire seals, internal seals, seal plugs, secondary locking wedges, attachment clips and socket/pin terminals. Also included is a compartmented storage box, carrying case and a FLAT BLADE L-HOOK (Part No. HD-41475-100) is used for the removal of all types of locking wedges.*

### Separating Pin and Socket Housings

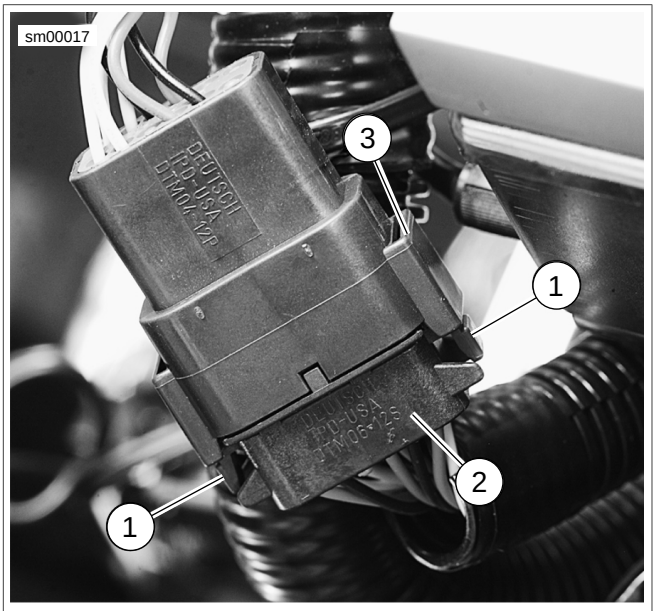
See Figure A-17. To separate the connector halves, depress the external latch(es) (1) on the socket housing (2) while rocking the pin (3) and socket housings.

*NOTES*

- *Generally, the socket housing is found on the accessory side, while the pin housing is plumbed to the wiring harness.*
- *Two-, three-, four- and six-place Deutsch connectors have one latch on the connector.*
- *Eight- and twelve-place connectors have a latch on each side. Simultaneously press both latches to separate the connector.*

### Mating Pin and Socket Housings

1. Align the connectors to match the wire lead colors.
   a. **For One External Latch:** Two-, three-, four- and six-place Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.
   b. **For Two External Latches:** (8-place and 12-place) Align the tabs on the socket housing with the grooves on the pin housing.
2. Insert socket housing into pin housing until it snaps or clicks into place.
   **For Two External Latches:** (8-place and 12-place) If latches do not click (latch), press on one side of the connector until that latch engages, then press on the opposite side to engage the other latch.
3. If necessary, fit the attachment clip to the pin housing.
4. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.




1. **External latch**
2. **Socket housing**
3. **Pin housing**

**Figure A-18. Deutsch Connector**

### Removing Socket Terminals

1. See Figure A-19. Insert a small screwdriver between the socket housing and locking wedge in-line with the groove (in-line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up and remove the secondary locking wedge.
2. See Figure A-22. Use a pick or small screwdriver to depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

*NOTE*

*If wire leads require **new** terminals, see the instructions for crimping terminals.*

### Installing Socket Terminals

1. Match wire lead color to connector cavity.
2. See Figure A-21. Fit rear wire seal (1) into back of socket housing (2), if removed.
3. Grasp wire lead (3) approximately 25.4 mm (1.0 in.) behind the socket terminal. Gently push socket through hole in wire seal into its chambers until it "clicks" in place.
4. A tug on the wire will confirm that it is properly locked in place.

*NOTE*

*Seal plugs (6) are installed through the wire seals of unused chambers. If removed, seal plugs must be replaced to seal the connector.*

5. Install internal seal (4) on lip of socket housing, if removed.
6. Insert tapered end of secondary locking wedge (5) into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

*NOTES*

- *See Figure A-20. While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (1) pointing toward the external latch.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

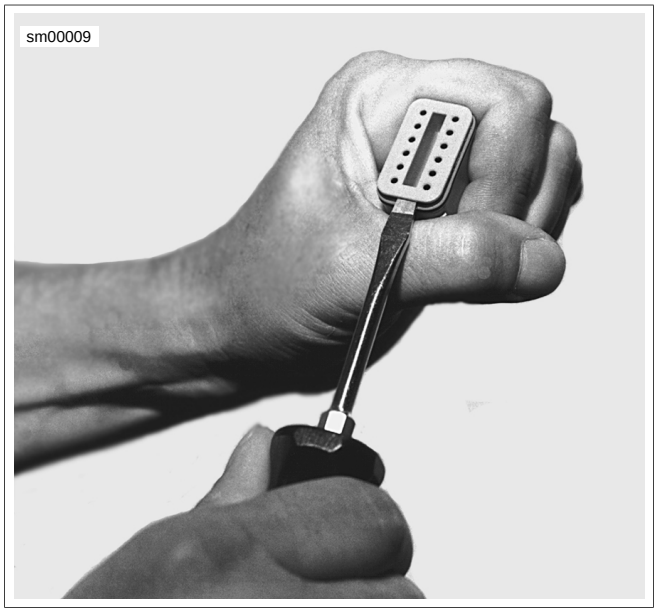
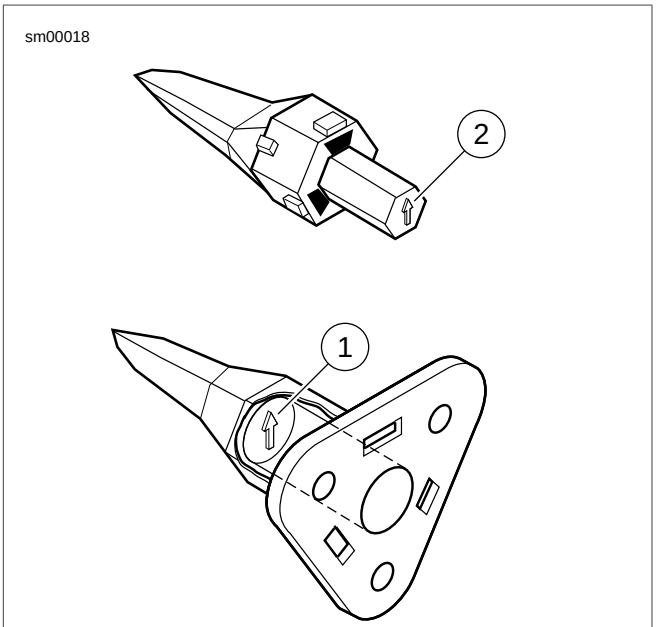
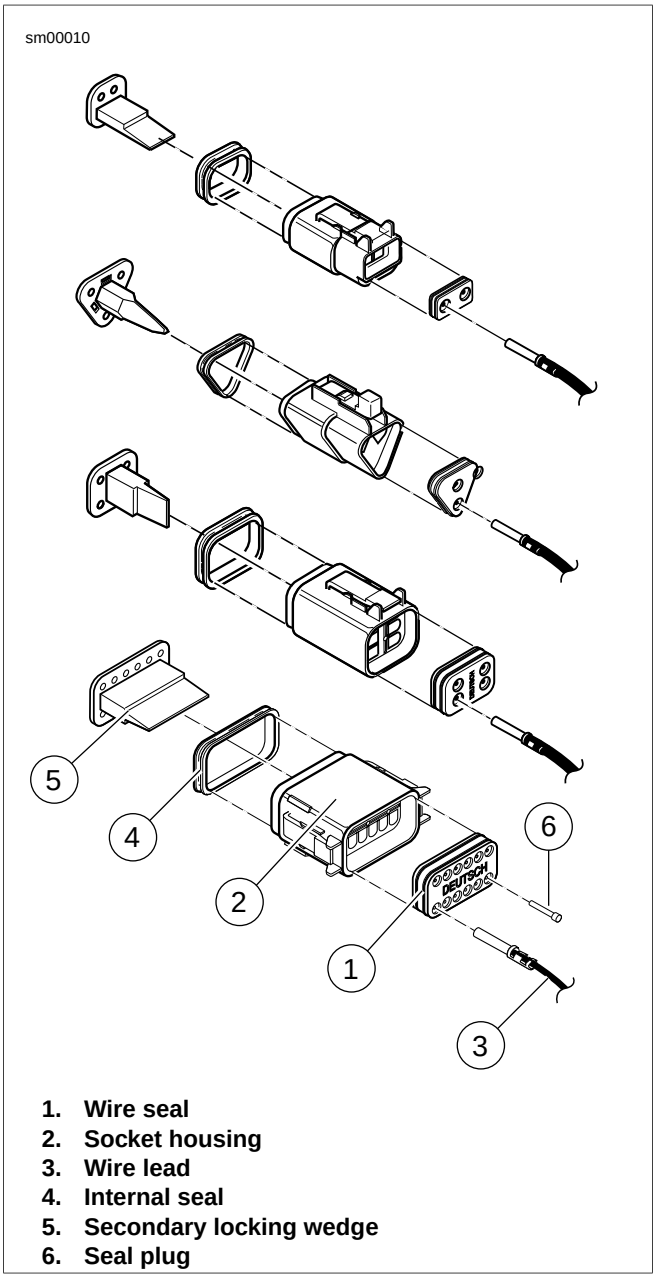



**Figure A-19. Deutsch Connector: Remove Secondary Locking Wedge**




1. **Arrow on socket locking wedge**
2. **Arrow on pin locking wedge**

**Figure A-20. Deutsch Connector: 3-Place Locking Wedges**




1. **Wire seal**
2. **Socket housing**
3. **Wire lead**
4. **Internal seal**
5. **Secondary locking wedge**
6. **Seal plug**

**Figure A-21. Deutsch Connector: 2, 3, 4 and 12-Place Socket Housings**

## Removing Pin Terminals

1. Use the hooked end of a stiff piece of mechanics wire, a needle nose pliers or the FLAT BLADE L-HOOK (Part No. HD-41475-100) to remove the secondary locking wedge.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

*NOTES*

- *If wire leads require **new** terminals, see the instructions for crimping terminals.*
- *If it should become necessary to replace a pin or socket housing, please note that the 8-place and 12-place gray and black connectors are not interchangeable. Since location of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color.*
- *When replacing both socket and pin housings, then the black may be substituted for the gray, and vice versa. The socket and pin housings of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.*

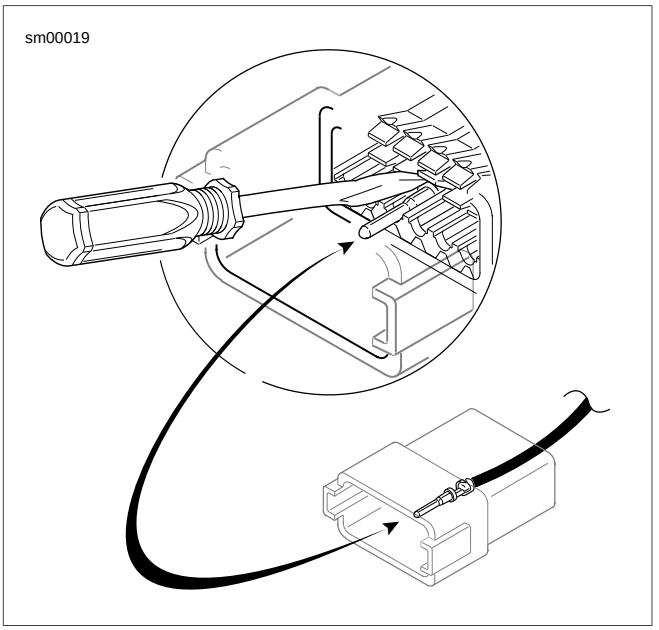



**Figure A-22. Deutsch Connector: Depress Terminal Latch and Back Out Pin**

## Installing Pin Terminals

1. See Figure A-23. Fit wire seal (1) into back of pin housing (2).
2. Grasp wire lead approximately 25.4 mm (1.0 in.) behind the pin terminal (3). Gently push pin through holes in wire seal into its respective numbered chamber until it "clicks" in place.

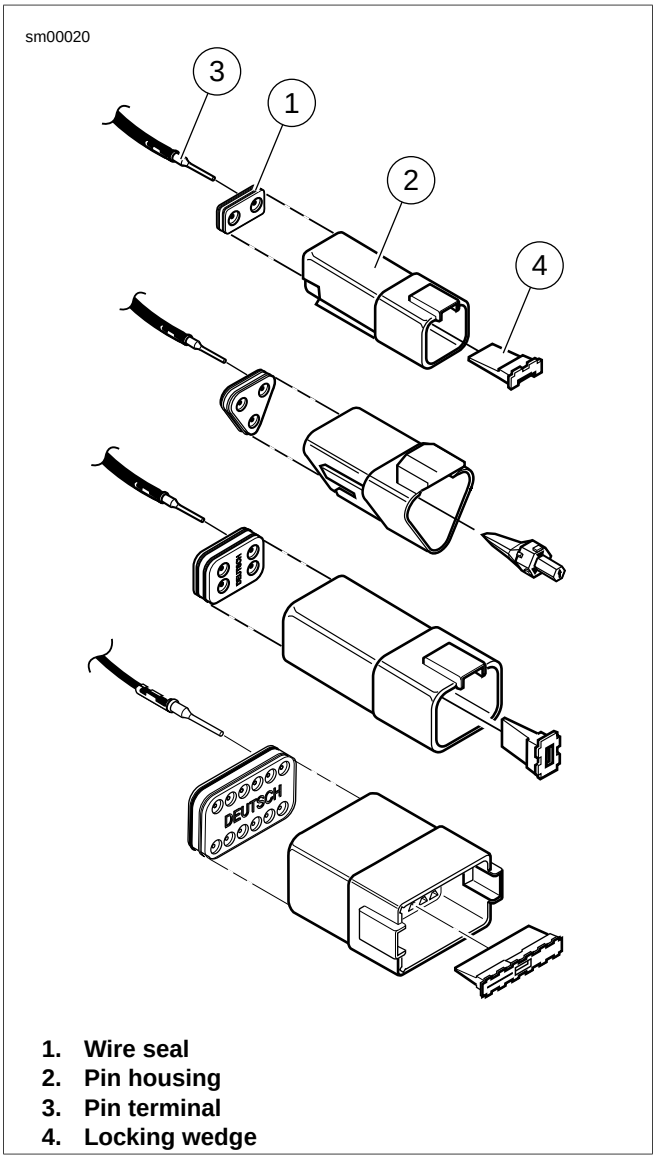
*NOTE*

*A tug on the wire lead will confirm that a pin is locked in place.*

3. Insert tapered end of secondary locking wedge (4) into pin housing and press down until it snaps in place.

*NOTES*

- *The wedge fits in the center groove of the pin housing and holds the terminal latches tightly closed.*
- *See Figure A-20. While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (2) pointing toward the external latch.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*




1. **Wire seal**
2. **Pin housing**
3. **Pin terminal**
4. **Locking wedge**

**Figure A-23. Deutsch Connector: 2, 3, 4 and 12-Place Pin Housings**

## Crimping Terminals

Identify which of the types of Deutsch terminals are used with the connector and follow the corresponding crimping instructions. Refer to Table A-2.

**Table A-2. Deutsch Connector: Terminal Crimping Instructions**

| TYPE | CRIMPING INSTRUCTIONS |
|---|---|
| Standard (with crimp tails) | A.9 DEUTSCH STANDARD TERMINALS |
| Mini Terminal (solid barrel) | A.10 DEUTSCH SOLID BARREL TERMINALS |
| Mini Terminal (with crimp tails) | A.8 DEUTSCH MINI-TERMINAL CRIMPS |

## DEUTSCH MINI TERMINAL CRIMPS

| PART NUMBER | TOOL NAME |
|---|---|
| HD-38125-7 | PACKARD TERMINAL CRIMPER |

## Preparing Wire Leads for Crimping

Strip wire lead removing 4.0 mm (5/32 in.) of insulation.

## Crimping a Mini Terminal to Wire Lead

1. See Figure A-24. Compress the handles of PACKARD TERMINAL CRIMPER (Part No. HD-38125-7) until the ratchet (2) automatically opens.

*NOTE*

*Always perform core crimp before insulation crimp.*

2. Position the core crimp on die E (1) of the crimper. Be sure the core crimp tails are facing the forming jaws.
3. Gently apply pressure to handles of tool until crimpers just secure the core crimp tails.
4. Insert stripped wire core stands between crimp tails. Position wire so that short pair of crimp tails squeeze bare wire strands, while long pair squeeze over the insulation.
5. Squeeze handle of crimper until tightly closed. Tool automatically opens when the crimping sequence is complete.

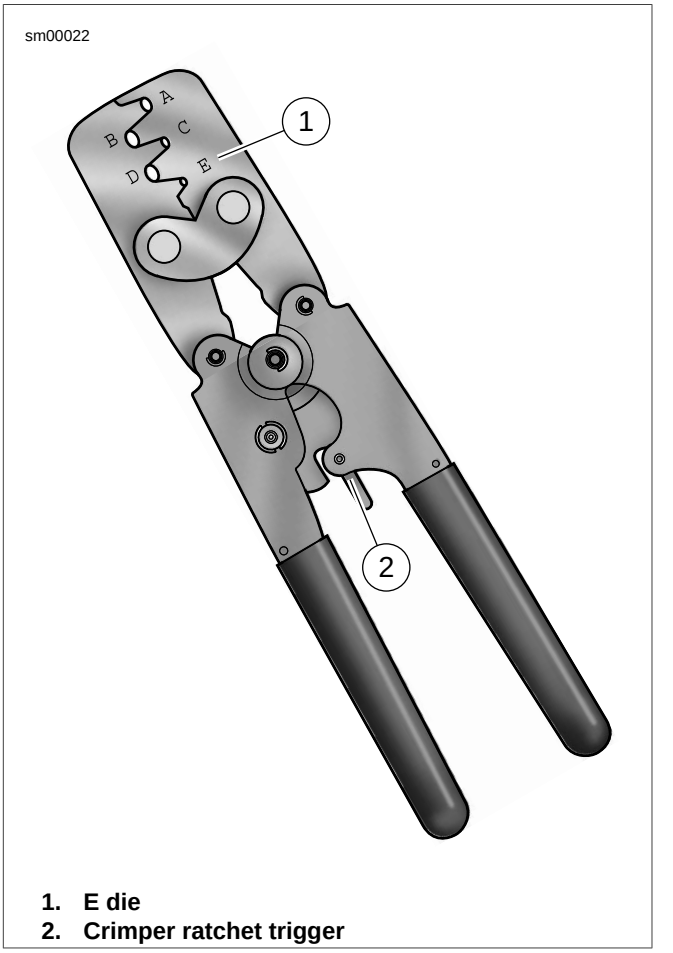
*NOTE*

*If the crimper does not open, it can be opened by squeezing the ratchet trigger (2).*

6. Position the insulation crimp on nest C of the crimper. Be sure the insulation crimp tails are facing the forming jaws.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.

## Inspecting Crimps

Inspect the core and insulation crimps. Distortion should be minimal.




**1. E die**
**2. Crimper ratchet trigger**

**Figure A-24. Packard Terminal Crimper (HD-38125-7)**

## DEUTSCH STANDARD TERMINAL CRIMPS

| PART NUMBER | TOOL NAME |
|---|---|
| HD-39965-A | DEUTSCH TERMINAL CRIMP TOOL |

### Preparing Wire Leads for Crimping

1. Use a shop gauge to determine gauge of wire lead.
2. Strip lead removing 4.0 mm (5/32 in.) of insulation.

### Crimping Terminal to Lead

1. See Figure A-25. Squeeze the handles of the DEUTSCH TERMINAL CRIMP TOOL (Part No. HD-39965-A) to open the jaws. Push the locking bar (1) up.
2. Insert (2) terminal (socket/pin) through hole of the locking bar, so that the rounded side of the contact barrel rests in the nest (concave split level area) with the crimp tails facing upward. To match the wire gauge to the crimp tool die, refer to Table A-3.
3. Release locking bar to lock terminal in die.

*NOTE*

*If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the terminal so that the tails face straight upward. When positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.*

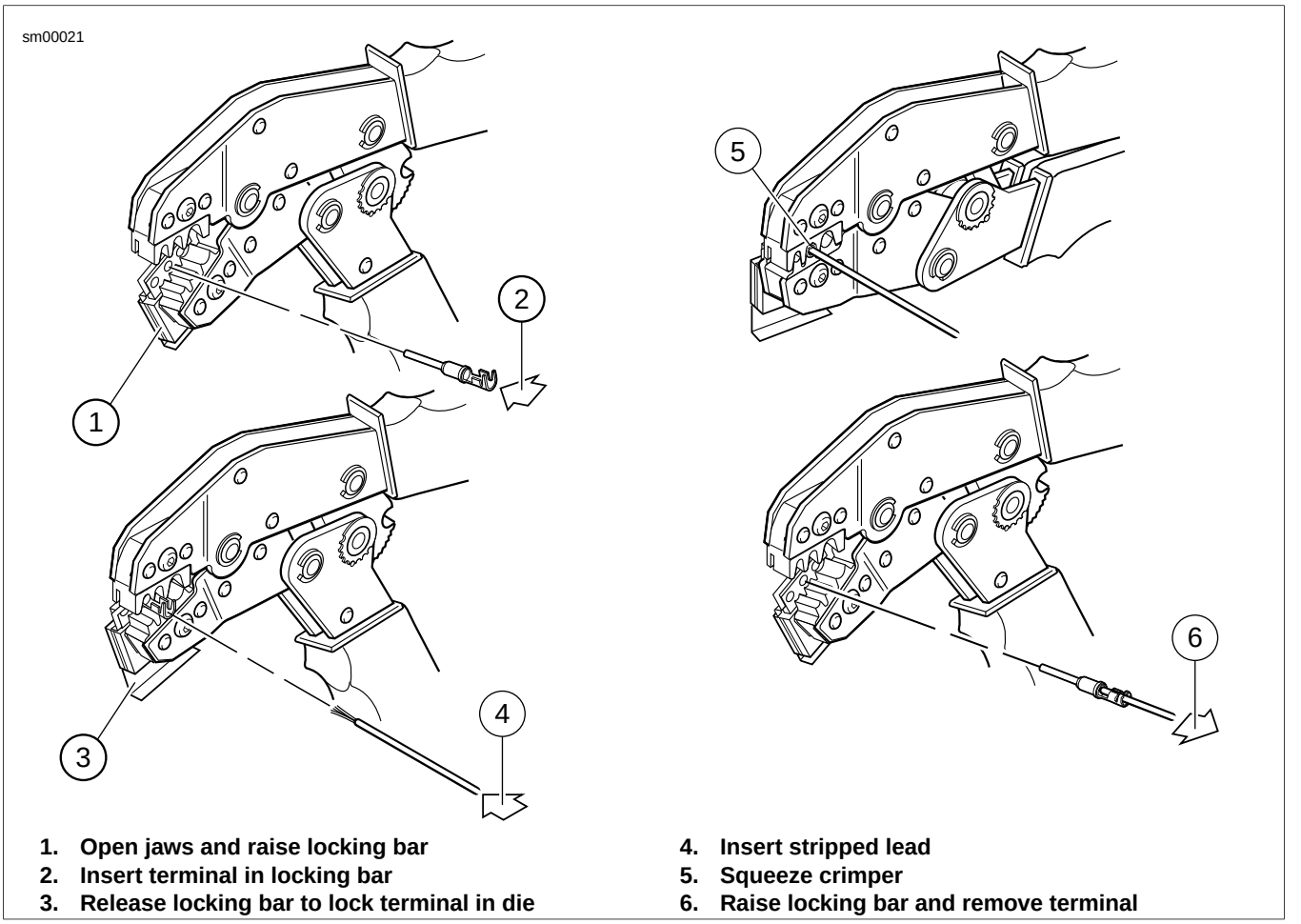
4. Insert stripped wire core between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over the insulation.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens after the terminal is crimped.
6. Raise locking bar up and remove wire lead and terminal.

### Inspecting Crimps

Inspect the wire core and insulation crimps. Distortion should be minimal.

**Table A-3. Deutsch Standard Terminal Crimp: Wire Gauge To Die**

| WIRE GAUGE (AWG) | CRIMP TOOL DIE |
|---|---|
| 20 | Front |
| 16-18 | Middle |




1. **Open jaws and raise locking bar**
2. **Insert terminal in locking bar**
3. **Release locking bar to lock terminal in die**
4. **Insert stripped lead**
5. **Squeeze crimper**
6. **Raise locking bar and remove terminal**

**Figure A-25. Crimping a Deutsch Standard Terminal**

## DEUTSCH SOLID BARREL TERMINAL CRIMPS

| PART NUMBER | TOOL NAME |
|---|---|
| HD-42879 | ELECTRICAL CRIMPER TOOL |

### Preparing Wire Leads For Crimping

For size 20, 16 and 12 contacts, wire ranges 26-12 AWG.

Strip wire lead removing 6.4 mm (1/4 in.) of insulation.

### Adjusting Crimper Tool

1. See Figure A-26. Squeeze the ELECTRICAL CRIMPER TOOL (Part No. HD-42879) handles to cycle the crimp tool to open.
2. Remove locking pin (1) from selector knob (2).
3. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with "SEL. NO." arrow (3).
4. Loosen knurled locknut (4) and turn adjusting screw (5) clockwise (in) until it stops.

### Crimping a Barrel Contact To Wire Lead

1. See Figure A-27. Turn tool over and drop contact barrel (1) into indentor cover (2) hole with the wire end out.
2. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
3. Slowly squeeze handles of crimp tool until contact is centered between the four indentor points (3).
4. Insert bare wire core strands of stripped wire lead (4) into contact barrel. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
5. Remove wire lead with crimped contact from indentor.

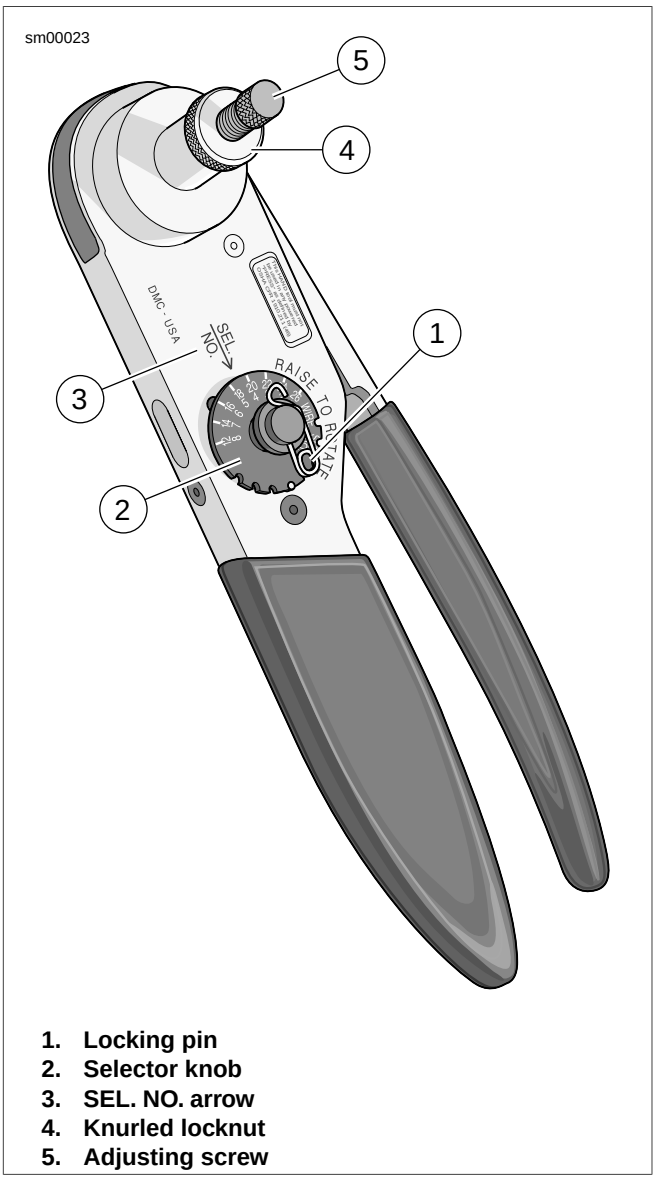
*NOTE*

*Tool must be readjusted when changing contact size/type.*

6. Install pin to lock selector knob.

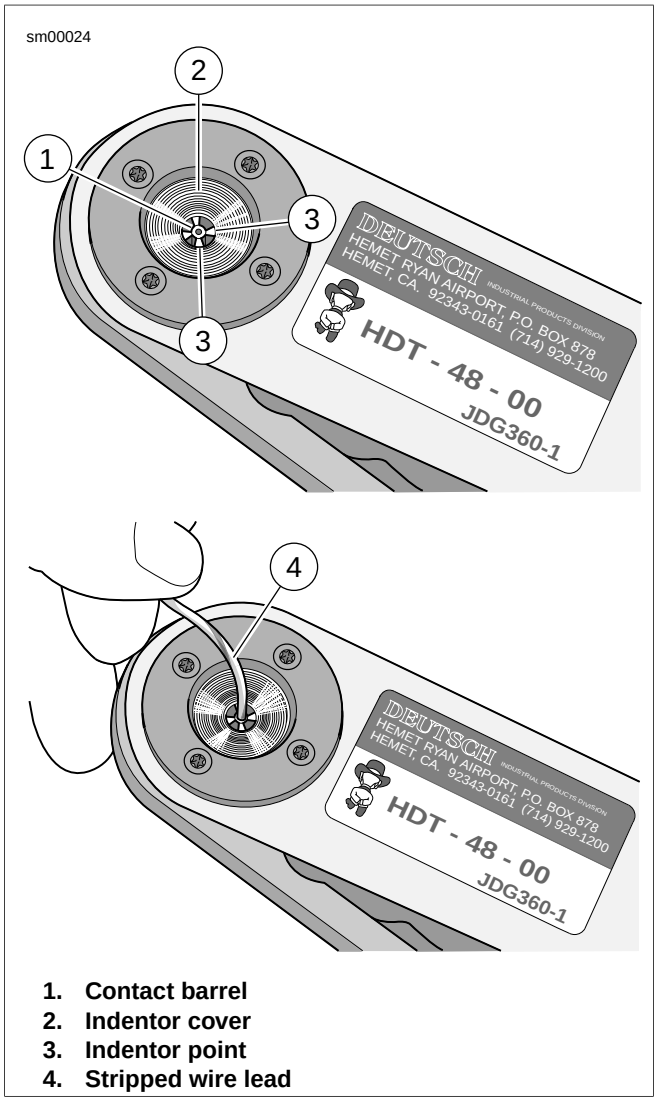
### Inspecting Crimps

Inspect the crimp. All core wire strands are to be crimped in the barrel.




1. **Locking pin**
2. **Selector knob**
3. **SEL. NO. arrow**
4. **Knurled locknut**
5. **Adjusting screw**

**Figure A-26. Electrical Crimper Tool (HD-42879)**




1. **Contact barrel**
2. **Indentor cover**
3. **Indentor point**
4. **Stripped wire lead**

**Figure A-27. Deutsch Solid Barrel**

## MOLEX CONNECTOR REPAIR

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48114 | MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER |

### Separating Pin and Socket Housings

See Figure A-28. Depress the latch while pulling the pin and socket housings apart.

### Mating Pin and Socket Housings

1. Orient the latch on the pin housing to the latch pocket on the socket housing so the rails on the outside of the pin housings lines up with the tunnels on the socket housing.
2. Press the housings together until the latch clicks.

### Removing Terminals

1. Pull the secondary lock up, approximately 4.8 mm (3/16 in.), until it stops.
   a. **Socket Housing:** See Figure A-29. Use a small screwdriver in the pry slot. The slot next to the external latch provides a pivot point.
   b. **Pin Housing:** See Figure A-30. Use needle nose pliers to engage the D-holes in the center of the secondary lock.

*NOTE*

*Do not remove the secondary lock from the connector housing.*

2. See Figure A-31. Insert MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER (Part No. HD-48114) into the pin hole next to the terminal until the tool bottoms.
   a. **Socket Housing:** The pin holes are inside the terminal openings.
   b. **Pin Housing:** The pin holes are outside the pins.
3. Pressing the terminal remover to the bottom of the pin hole, gently pull on the wire to remove wire terminal from its cavity.

### Installing Terminals

1. See Figure A-32. From the wiring diagram, match the wire color to its numbered terminal cavity.

*NOTE*

*Cavity numbers (1) are stamped on the housing at the ends of the cavity rows. The cavity number can be determined by counting the cavities up or down along the row from each stamped number.*

2. Orient the terminal so that the tang (2) opposite the open crimp engages the slot (3) in the cavity.
3. Push the terminal into the cavity.
4. Gently tug on wire to verify that the terminal is captured by the secondary lock.
5. With all terminals installed, push the secondary lock into the socket housing to lock the wire terminals into the housing.

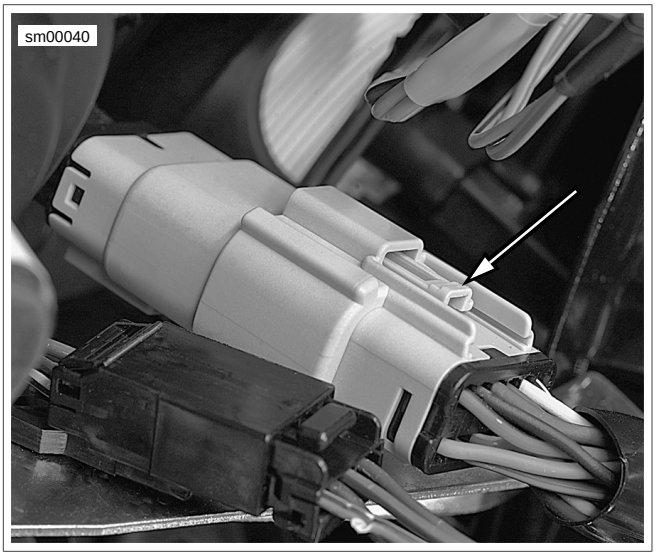



**Figure A-28. Molex Connector: Latch**




**Figure A-29. Secondary Lock Pry Slot (Socket Housing)**

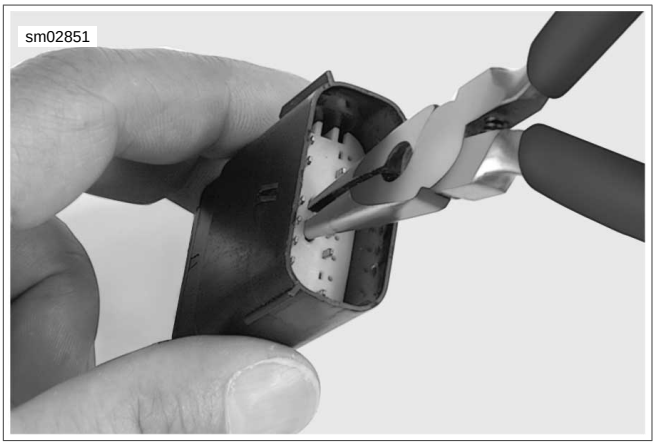



**Figure A-30. Pull Up Secondary Lock (Pin Housing)**

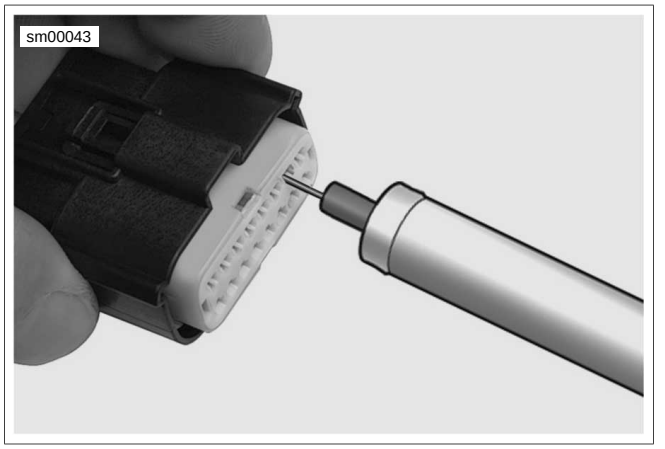
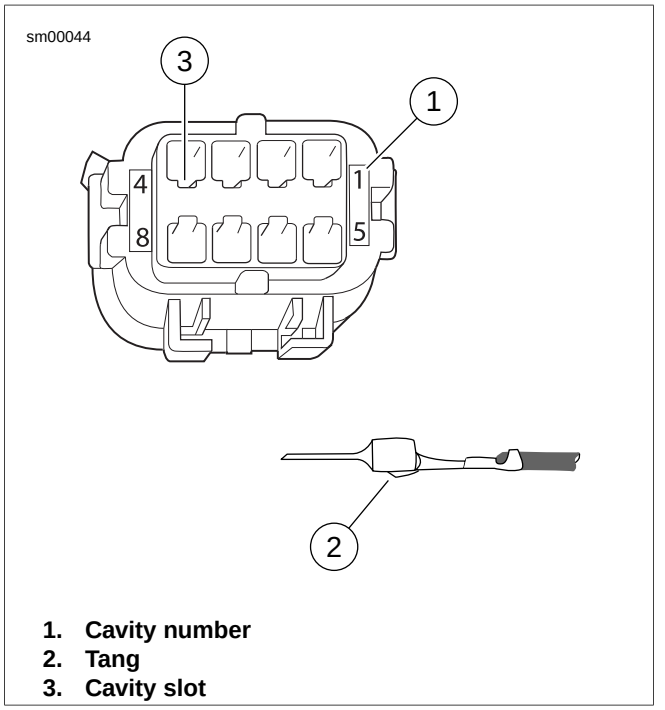



**Figure A-31. Molex Connector: Terminal Remover (HD-48114)**




1. **Cavity number**
2. **Tang**
3. **Cavity slot**

**Figure A-32. Molex Connector: Pin Cavities and Wire Terminal**

## CRIMP TERMINAL TO LEAD

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48119 | ELECTRICAL CRIMP TOOL |

### Prepare Lead

1. Cut the damaged terminal close to the back of the terminal to leave as much wire length as possible.
2. Strip approximately 4.70-5.60 mm (3/16 in.) of insulation from the end of the wire lead.

*NOTE*

*The strip length is the same for both pin and socket terminals and for wire gauges from 22 to 14.*

### Prepare Tool

1. Identify the punch/die in the jaws of the ELECTRICAL CRIMP TOOL (Part No. HD-48119) for the wire gauge. Refer to Table A-4.
2. Squeeze and release the handles to open the tool.

*NOTE*

*The crimp tool automatically opens when the handles are released.*

3. See Figure A-33. Hold fully open tool at approximately 45 degrees.

*NOTE*

*Do NOT tighten the locknut holding the locator bars. The bars must float to accommodate the different terminal gauges.*

**Table A-4. Crimp Tool Wire Gauge Punch/Die**

| AWG (WIRE GAUGE) | PUNCH/DIE |
|---|---|
| 22 | Left |
| 18-20 | Middle |
| 14-16* | Right |
| * Crimp 16 AWG **pin** terminals in the 18-20 middle die. | |

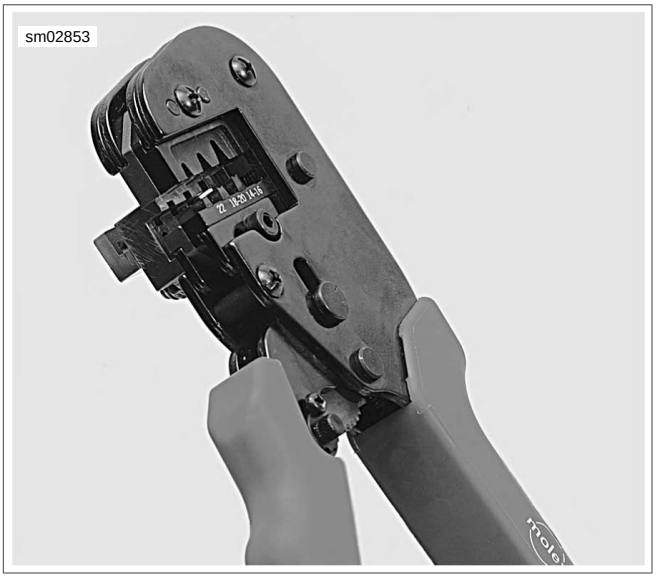
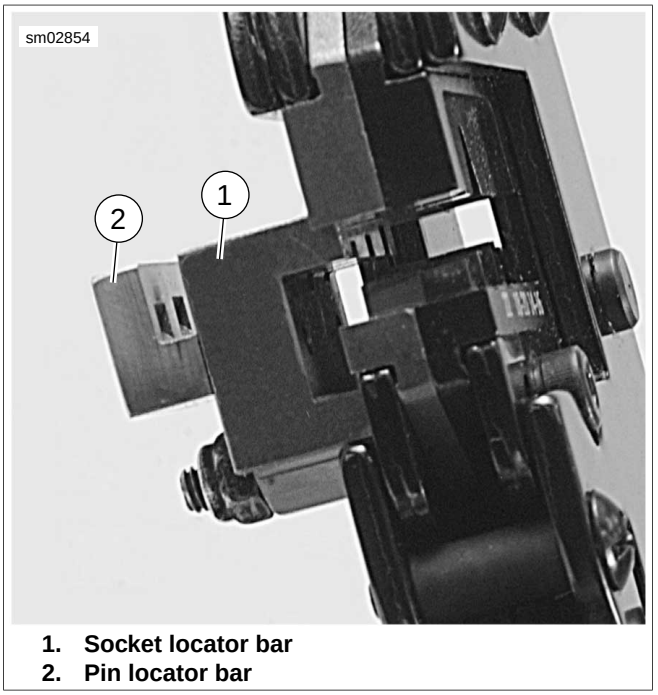



**Figure A-33. Open Electrical Crimp Tool (HD-48119) at 45 Degrees**




1. **Socket locator bar**
2. **Pin locator bar**

**Figure A-34. Terminal Locator Bars**

## Position Terminal in the Punch/Die

1. See Figure A-35. With the crimp tails up, place the terminal through the punch/die into the square opening in the socket locator bar.
   a. **Socket Terminal:** See Figure A-34. A socket terminal stops against the back face of the socket locator bar (1).
   b. **Pin Terminal:** See Figure A-36. The tip of a pin terminal passes through the socket locator bar and stops in the notch in the face of the pin locator bar.
2. See Figure A-37. Ratchet the handles together until the crimp tails are held in vertical alignment between the punch and the die.

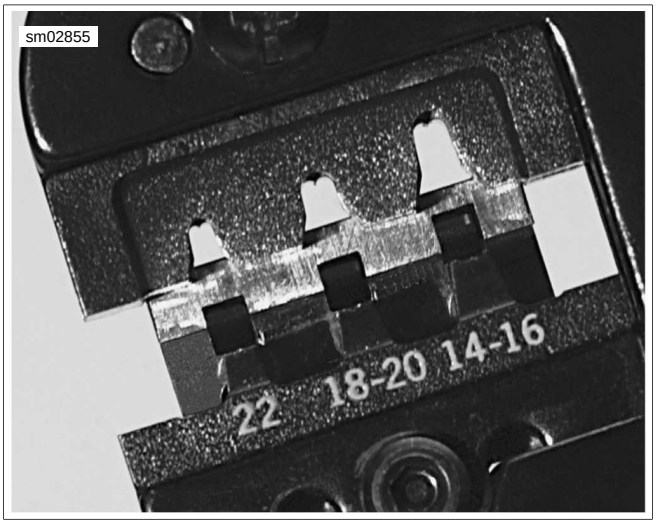



**Figure A-35. Square Openings in Socket Locator Bar**

## Insert Stripped Lead

See Figure A-38. Insert the stripped end (wire core) between the crimp tails at an up angle until the wire core touches the face of the socket locator bar above the square opening.

*NOTES*

- *The insulation must extend through the insulation crimp tails.*
- *Insert the wire with little or no pressure. Pressing on the lead will bend the wire core.*

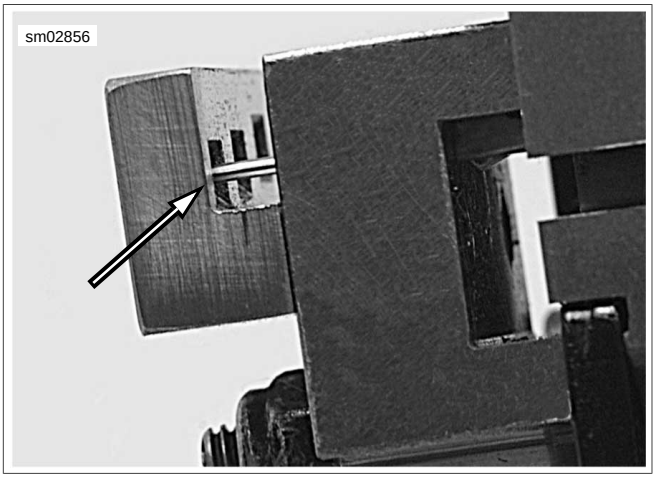



**Figure A-36. Pin Terminal against Pin Locator Bar**

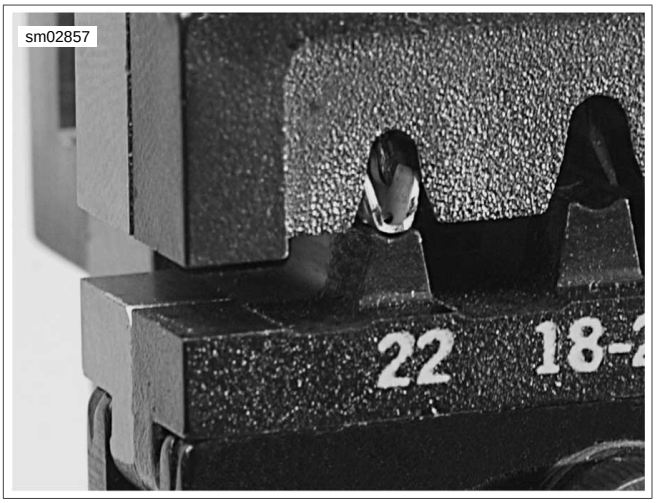



**Figure A-37. Crimp Tails in Vertical Alignment between Punch and Die**

## Crimp Terminal to Lead

1. Holding the wire lead in position touching the locator face at an angle, quickly and smoothly squeeze the crimp tool closed.
2. Final squeeze the handles to open the tool and release the terminal.

*NOTE*

*A stuck or jammed tool can be opened by pressing the ratchet release lever found between the handles. Do* ***not*** *force the handles open or closed.*

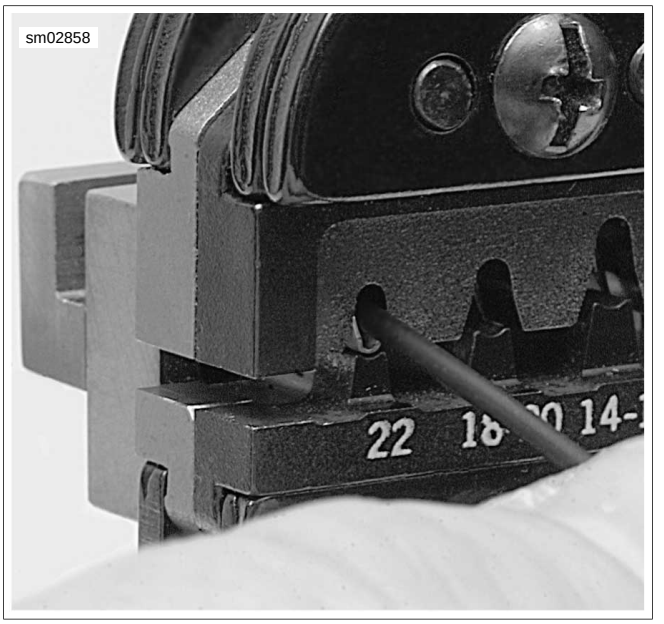
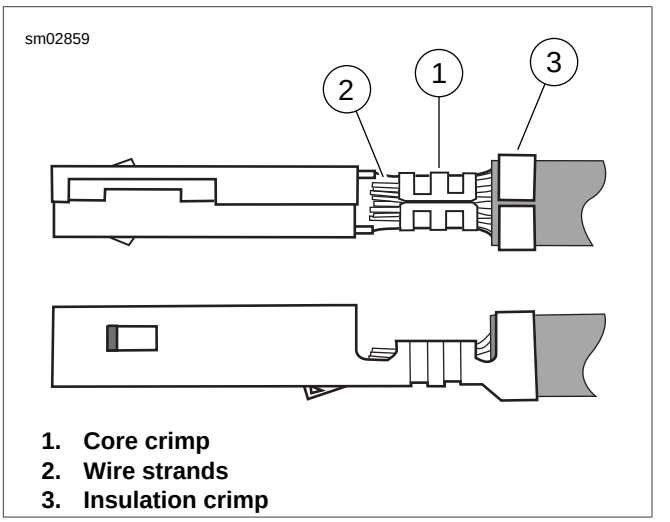



**Figure A-38. Stripped Lead at Up Angle**

## Inspect Crimp

1. **Inspect Crimp:** Inspect the core and insulation crimp.
   a. See Figure A-39. The core tails should be creased into the wire strands at the core crimp (1).
   b. Strands (2) of wire should be visible beyond the core crimp but not forward into the terminal shell.
   c. The insulation tails should be folded into the insulation (3) without piercing or cutting the insulation.
   d. Distortion should be minimal.
2. **Test Crimp:** Hold the terminal and pull the lead.




**1. Core crimp**
**2. Wire strands**
**3. Insulation crimp**

**Figure A-39. Terminal Crimp**

## 150 METRI-PACK CONNECTOR REPAIR

### General

Metri-Pack connectors are embossed with the initials (P.E.D.).

There are two types of connectors in this series:

- Pull-to-Seat
- Push-to-Seat

### Separating Pin and Socket Housings

Bend back the external latch slightly and separate the pin and socket halves of the connector.

### Mating Pin and Socket Housings

Align the wire colors and push the pin and socket halves of the connector together.

### Removing Socket Terminal

1. See Figure A-40 for pull-to-seat connector or Figure A-41 for push to seat connector. Remove wire lock (1) from wire end of socket housing on push-to-seat type connectors.

*NOTE*

*For best results, free one side of wire lock first and then release the other side.*

2. Find the locking tang in the mating end of the connector.

*NOTE*

*The tangs are always positioned in the middle of the chamber and are on the same side as the external latch.*

3. Gently insert a safety pin into the chamber about 3.2 mm (1/8 in.).
   a. **For pull-to-seat:** Stay between the terminal and the chamber wall and pivot the end of the pin toward the terminal body.
   b. **For push-to-seat:** There is a small opening for the pin.
4. When a click is heard, remove the pin and repeat the procedure.

*NOTE*

*The click is the sound of the tang returning to the locked position as it slips from the point of the pin.*

5. Pick at the tang until the clicking stops and the pin seems to slide in deeper than it had previously. This is an indication that the tang has been depressed.

*NOTE*

*On those terminals that have been extracted on multiple occasions, the click may not be heard, but pivot the pin as if the click was heard at least 3 times.*

6. Remove the pin.
   a. **For pull-to-seat:** Push on the lead to extract the terminal from the mating end of the connector.
   b. **For push-to-seat:** Pull on the lead to draw the terminal out the wire end.

### Inserting Socket Terminal

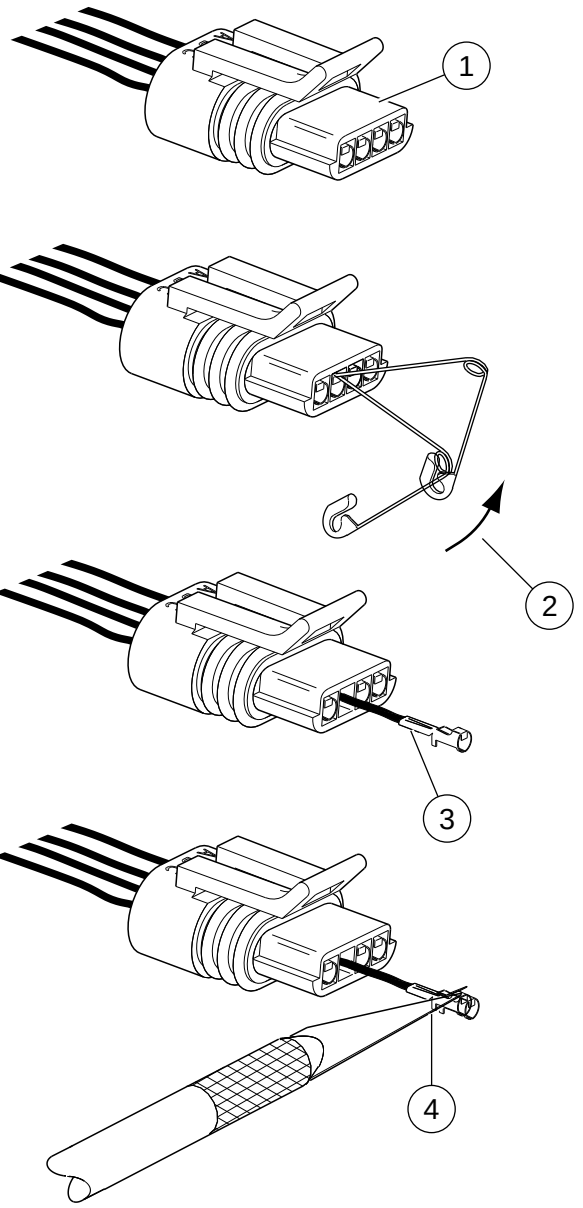
*NOTE*

*For wire location purposes, alpha characters are stamped into the socket housings.*

1. See Figure A-40 for pull-to-seat connector or Figure A-41 for push to seat connector. Using a thin flat blade, like that on a hobby knife, carefully bend the tang outward away from the terminal body.
2. Gently pull or push on the lead to install the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Gently pull or push on the lead to verify that the terminal is locked in place.

   **For push-to-seat:** See Figure A-41. Seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.

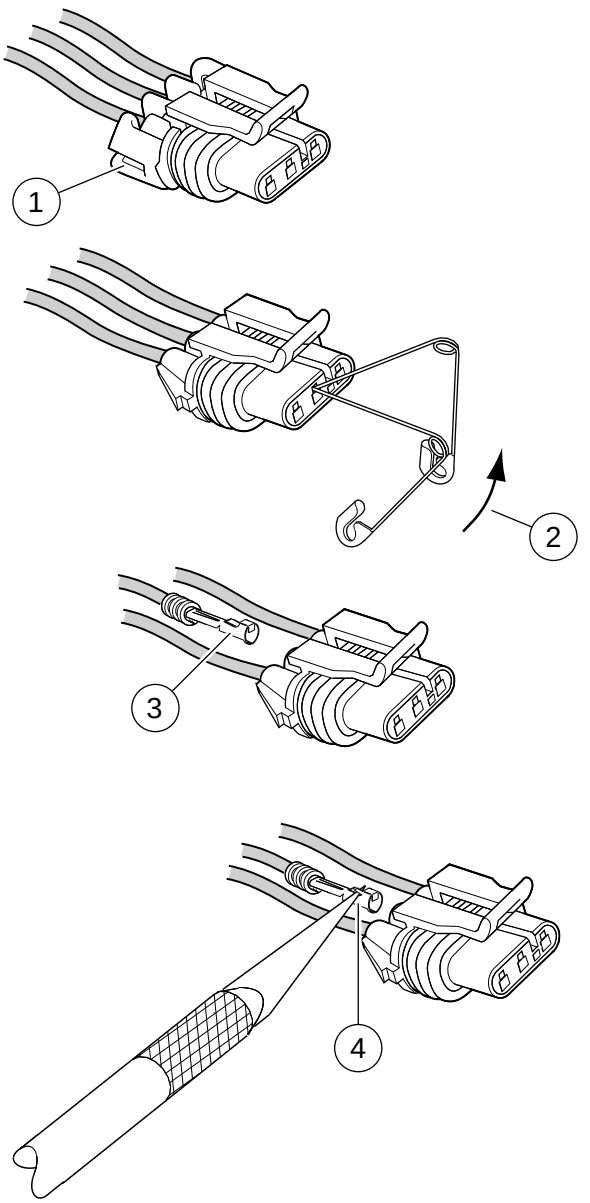
sm00027




1. Locate tang in chamber
2. Pivot pin to depress tang
3. Push to remove
4. Raise tang to install

**Figure A-40. 150 Metri-Pack Connector: Pull-to-Seat**

sm00028




1. Remove wire lock
2. Pivot pin to depress tang
3. Pull to remove
4. Raise tang to install

**Figure A-41. 150 Metri-Pack Connector: Push-to-Seat**

## FUSE BLOCK REPAIR

### Removing Socket Terminals

1. See Figure A-42. To remove secondary locks, insert end of small flat blade screwdriver (1) under lip of locking wedge (2) and gently pry up secondary lock.

*NOTE*

*For best results, start with locking wedge on outboard side of secondary lock.*

2. Looking into chamber at top of fuse block, note the tang next to each socket terminal.
3. Using a thin flat blade, like that on a hobby knife, gently push tang away from terminal, and then tug on wire to back terminal out.

### Installing Socket Terminals

1. Match the wire lead color to the fuse block terminal cavity.

*NOTES*

- *Refer to the main harness wiring diagram for wire lead color codes.*
- *See Figure A-43. The main fuse block terminal cavity is identified as alpha (1) and numeric (2) coordinates. Refer to the main harness wiring diagram for fuse block terminal cavity coordinates.*

2. With the open side of the socket terminal facing the tang, push lead into chamber at the wire end of the fuse block. A click is heard when the terminal is properly engaged.
3. Gently tug on the wire to verify that the terminal is locked in place and will not back out of the chamber.
4. Install the secondary locks. With the locking wedges positioned above the tangs in each chamber, slide flat side of secondary lock into slot (between rows), and push down until it bottoms.

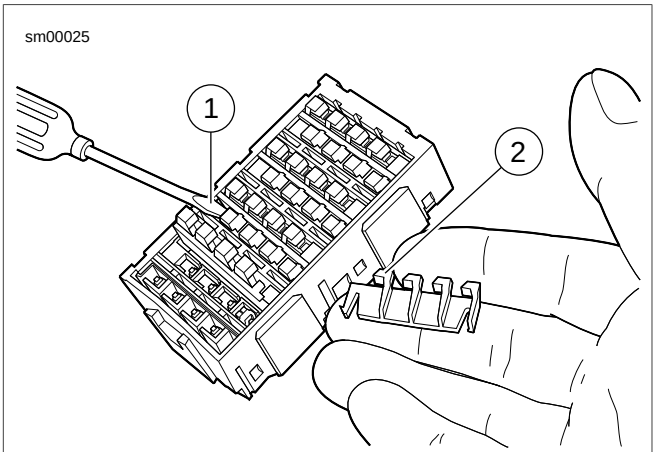
### Crimping Terminals

Terminals are crimped twice; once over the wire core and a second time over the insulation/seal.

A correctly crimped terminal may require different crimping dies found on separate crimpers.

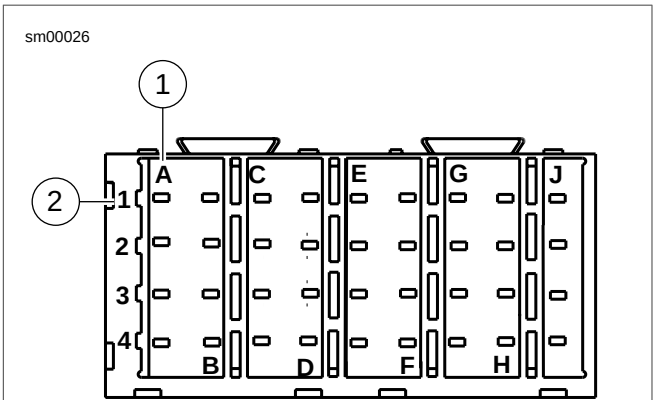
*NOTE*

*The wiring diagram indicates when one socket terminal is be crimped to two wire leads.*




**1. Pry up secondary lock**
**2. Lip of locking wedge**

**Figure A-42. Fuse Block: Remove Secondary Locks**




**1. Alpha**
**2. Numeric**

**Figure A-43. Fuse Block: Coordinates (typical)**

## 480 METRI-PACK CONNECTOR REPAIR

### General

A 480 Metri-Pack (P.E.D.) connector is frequently used for the B+ (battery voltage) connector to power P&A accessories.

Referred to as Packard connectors, Metri-Pack connectors are embossed with the initials P.E.D.

### Separating Pin and Socket Housings

*NOTE*

*Cut any cable strap anchoring the wire conduits of the pin (accessory connector housing) and the socket (B+) housing.*

See Figure A-44. Using small flat blade screwdriver, depress button (1) on pin housing (red wire) side of the connector and pull apart the pin and socket housings.

### Mating Pin and Socket Housings

Orient the latch on the socket housing to the button catch on the pin housing and press the housings together.

### Removing Socket Terminals

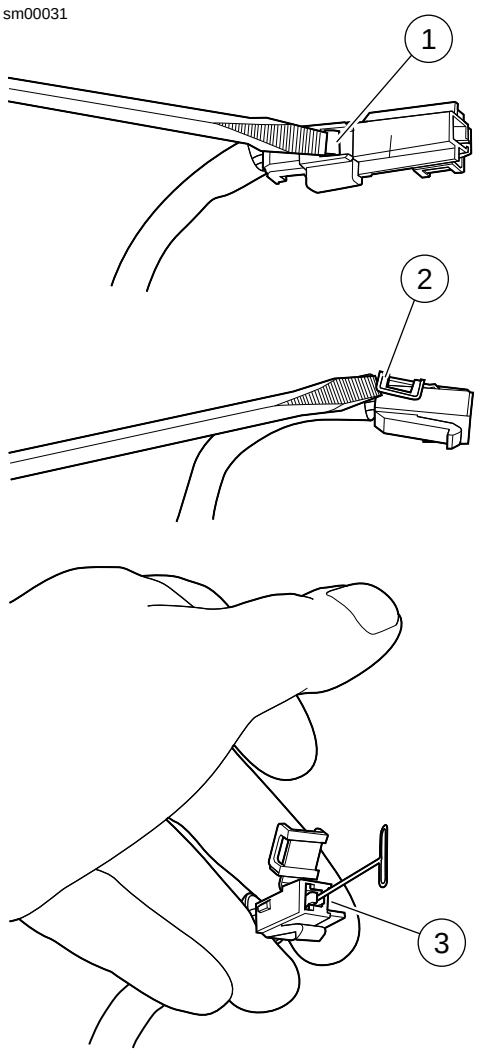
1. See Figure A-44. Bend back the latch (2) slightly and free one side of secondary lock, then repeat to release the opposite side. Rotate the secondary lock outward on hinge to access terminal in chamber of connector housing.
2. On the mating end of the connector, note the tang in the square shaped opening centered next to the terminal. Gently insert the point of a stick pin or large safety pin into the opening (3) between the tang and the chamber wall until it stops.
3. Pivot the end of the pin toward the terminal body to depress the tang.
4. Remove the pin and then pull terminal out of the wire end of connector housing.
5. If necessary, crimp **new** terminals on wires. See A.16 PACKARD METRI-PACK TERMINALS.

### Installing Socket Terminals

1. Carefully bend the tang outward away from the terminal body.
2. With the tang on the same side as the square shaped opening in the mating end of the connector housing, feed terminal into wire end of connector housing until it "clicks" in place.
3. Verify that terminal will not back out of the chamber. A slight tug on the cable will confirm that it is locked.
4. Rotate the hinged secondary lock inward until latches fully engage tabs on both sides of connector housing.

*NOTE*

*If removed, install **new** anchored cable strap in O.E. location. Tighten cable strap to capture conduit of both accessory connector and B+ connector approximately 25.4 mm (1.0 in.) from housings.*




1. **Button on pin housing**
2. **Secondary lock latch**
3. **Opening between tang and chamber wall**

**Figure A-44. 480 Metri-Pack Connector: Remove Socket Terminal**

## 630 METRI-PACK CONNECTOR REPAIR

| PART NUMBER | TOOL NAME |
|---|---|
| SNAP-ON TT600-3 | SNAP-ON PICK |

### General

Referred to as Packard connectors, Metri-Pack 630 series connectors are embossed with the initials P.E.D.

### Separating Pin and Socket Housings

*NOTE*

*If necessary, remove connector from barbed anchor or other retaining device.*

Bend back the external latch slightly and separate pin and socket halves of the connector.

### Mating Pin and Socket Housings

Orient the latch to the catch and push the pin and socket halves of the connector together until the latch "clicks".

*NOTE*

*If removed, install connector on barbed anchor or other OE retaining device.*

### Removing Socket Terminal

1. Bend back the latch slightly and free one side of the secondary lock. Repeat the step to unlatch the other side.
2. Rotate the secondary lock outward on hinge to view the terminals in the chambers of the connector housing. The locking tang is on the side opposite the crimp tails and engages a rib in the chamber wall to lock the terminal in place.
3. Moving to the mating end of the connector, take note of the small opening on the chamber wall side of each terminal.
4. Insert SNAP-ON PICK (Part No. SNAP-ON TT600-3) into opening until it stops. Pivot the end of the pick toward the terminal to depress the locking tang.
5. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat steps if the terminal is still locked in place.
6. If necessary, crimp **new** terminals on wires. Refer to A.16 PACKARD METRI-PACK TERMINALS.

### Installing Socket Terminal

*NOTE*

*Refer to the wiring diagrams to match wire lead colors to alpha characters molded into the secondary locks of each connector housing.*

1. Using a thin flat blade, like that of a hobby knife, carefully bend the tang outward away from the terminal body.
2. With the tang facing the chamber wall, push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

## METRI-PACK TERMINAL CRIMPS

| PART NUMBER | TOOL NAME |
|---|---|
| HD-38125-6 | PACKARD TERMINAL CRIMP TOOL |
| HD-38125-7 | PACKARD TERMINAL CRIMPER |
| HD-38125-8 | PACKARD CRIMPING TOOL |

### Matching Terminal To Crimper

Metri-Pack connectors embossed with the initials P.E.D. require Packard crimp tools to crimp terminals to wire leads.

Terminals are crimped twice to a wire lead, once over the wire core and a second time over the insulation/seal.

See Figure A-45. A completed crimp may require two different crimping dies found on PACKARD TERMINAL CRIMP TOOL (Part No. HD-38125-6) and/or PACKARD TERMINAL CRIMPER (Part No. HD-38125-7). The terminal (pin or socket) and the wire lead gauge will determine the core crimp die and the insulator/seal die.

*NOTE*

*The PACKARD CRIMPING TOOL (Part No. HD-38125-8) will also crimp sealed splice connectors in wire gauge sizes 18-20, 14-16 and 10-12.*

### Preparing Wire Lead

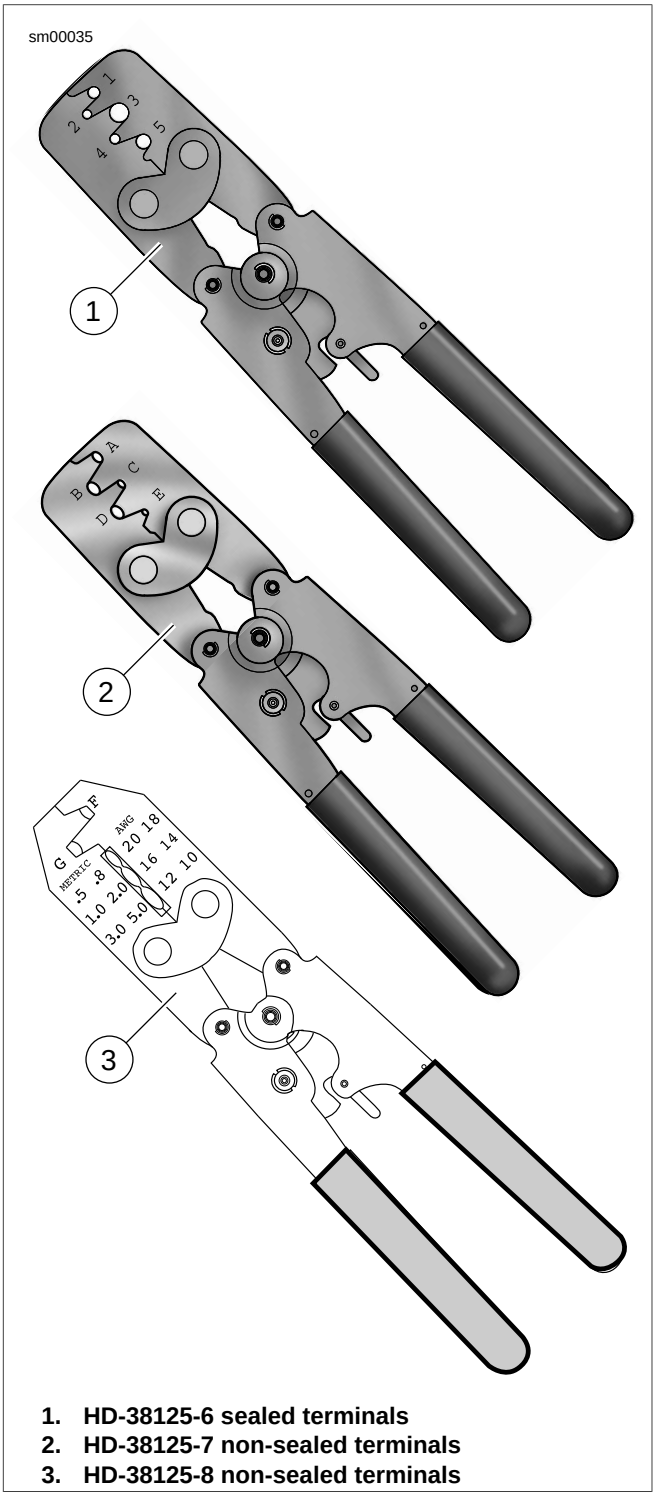
Use a wire striper to strip off the insulation and expose 4.0 mm (5/32 in.) of wire core.

### Crimping Wire Core

*NOTE*

*Metri-Pack terminal crimps require two steps. Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.*

1. Squeeze and release handles until ratchet automatically opens.
2. Identify the corresponding sized nest for the core crimp.
3. Position the core crimp in the die. Be Sure the core crimp tails are facing the forming jaws.
4. Gently squeeze the handles until crimpers just secure the core crimp tails.
5. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze core wire strands, while long pair is positioned over the insulation or seal material.
6. Squeeze handles tightly closed. Release grip and the tool will automatically open.




1. **HD-38125-6 sealed terminals**
2. **HD-38125-7 non-sealed terminals**
3. **HD-38125-8 non-sealed terminals**

**Figure A-45. Metri-Pack Terminal Crimp Tools**

### Crimping Insulation/Seal

*NOTE*

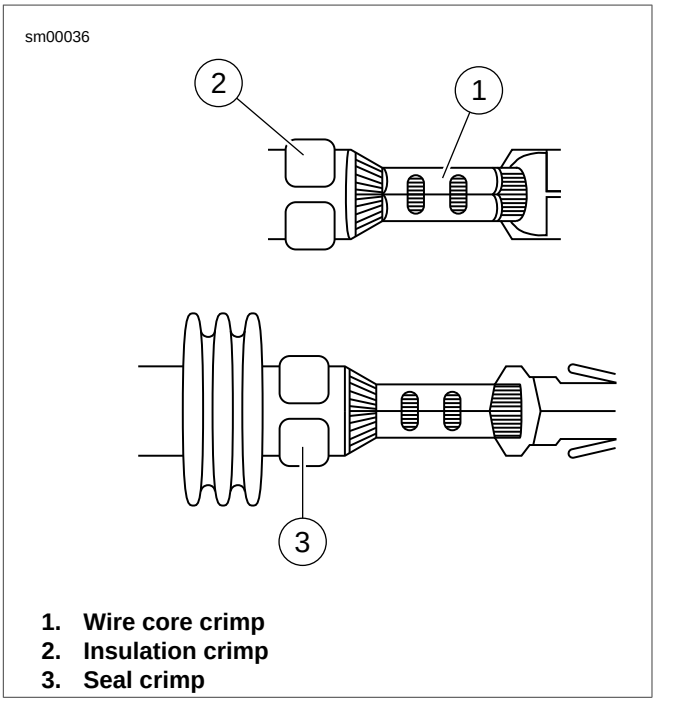
*Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.*

1. See Figure A-46. Identify the correct die for the insulation/seal crimp (2).

2. Position the insulation/seal crimp in the nest. Be sure the insulation/seal crimp tails are facing the forming jaws.
3. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimp is complete.

## Inspecting Crimps

1. See Figure A-46. Inspect the wire core crimp (1). The tails should be folded in on the wire core without any distortion or excess wire strands.
2. Inspect the insulation (2) or seal (3) crimp. The tails of the terminal should be wrapped around the insulation without distortion.




1. **Wire core crimp**
2. **Insulation crimp**
3. **Seal crimp**

**Figure A-46. Metri-Pack Connector: Inspect Core and Insulation/Seal Crimps**

## PACKARD 100W CONNECTOR REPAIR

### General

A Packard 100W connector connects the the electronic control module (ECM) to the main harness.

*NOTE*

*For vehicles with 73-pin connectors, see A.18 PACKARD MICRO-64 CONNECTORS and A.16 PACKARD METRI-PACK TERMINALS.*

### Separating Socket Housing From ECM

See Figure A-47. While pressing the connector into the ECM, press the thumb lever (1) against the connector until the latch (2) pops out of the catch (3) on the ECM.

### Mating Socket Housing To ECM

Push the connector into the ECM until the latch is captured by the catch on the ECM.

### Removing Socket Terminal

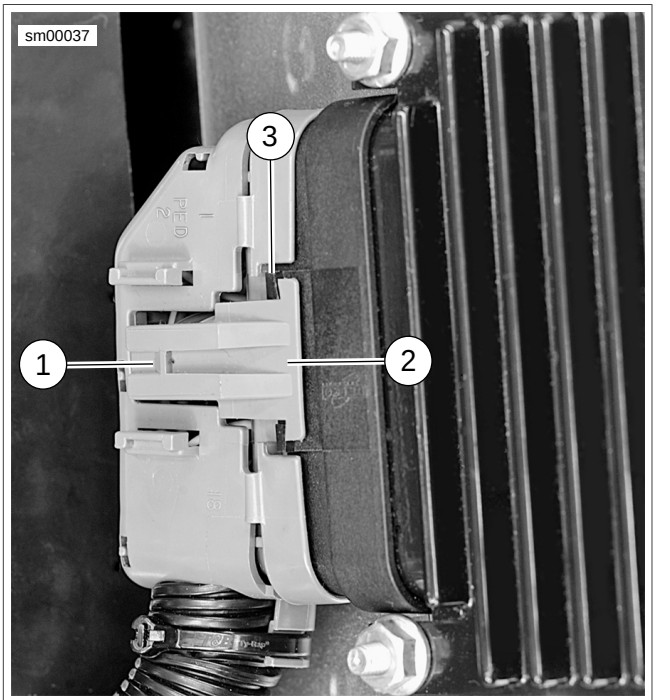
1. See Figure A-48. Gently depress latch (1) on each side of the clear plastic secondary lock (2) and remove. For best results, release one side at a time.
2. Carefully cut cable strap (3) to free strain relief collar (4) from conduit (5).
3. See Figure A-49. Using a thin blade, gently pry at seam at back of socket housing to release three plastic pins (1) from slots in housing. Separate and spread halves of socket housing.
4. Push on wire lead to free terminal from chamber.

### Installing Socket Terminal

1. From inside socket housing, gently pull on wire to draw terminal into chamber.
2. Exercising caution to avoid pinching wires, press halves of socket housing together until three plastic pins fully engage slots in housing.
3. Install **new** cable strap in groove of strain relief collar capturing cable conduit.
4. With the two ribs on the secondary lock on the same side as the external latch, install over terminals until latches lock in place.

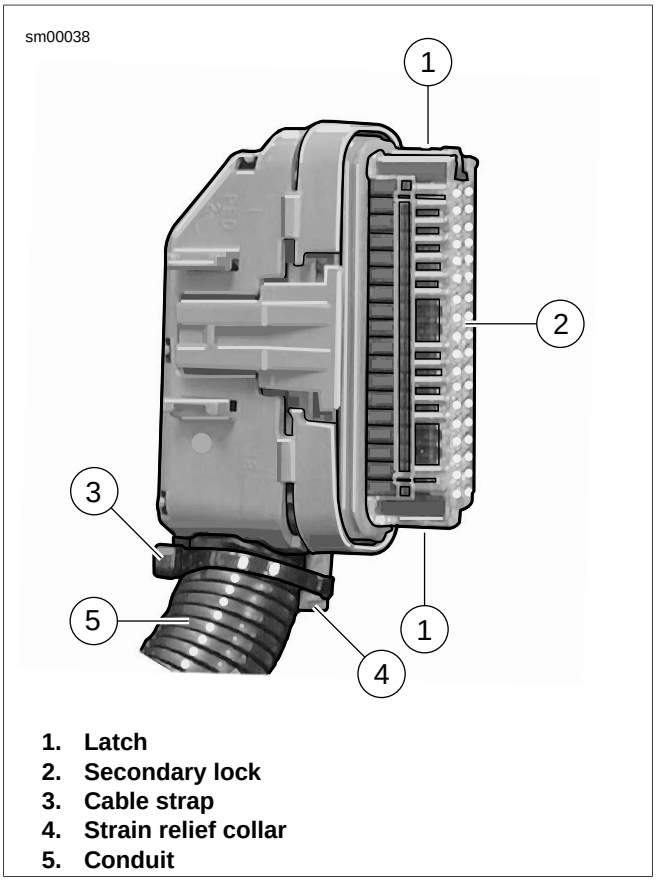
### Crimping Terminals

If necessary, crimp new terminals on wire leads. See A.16 PACKARD METRI-PACK TERMINALS.



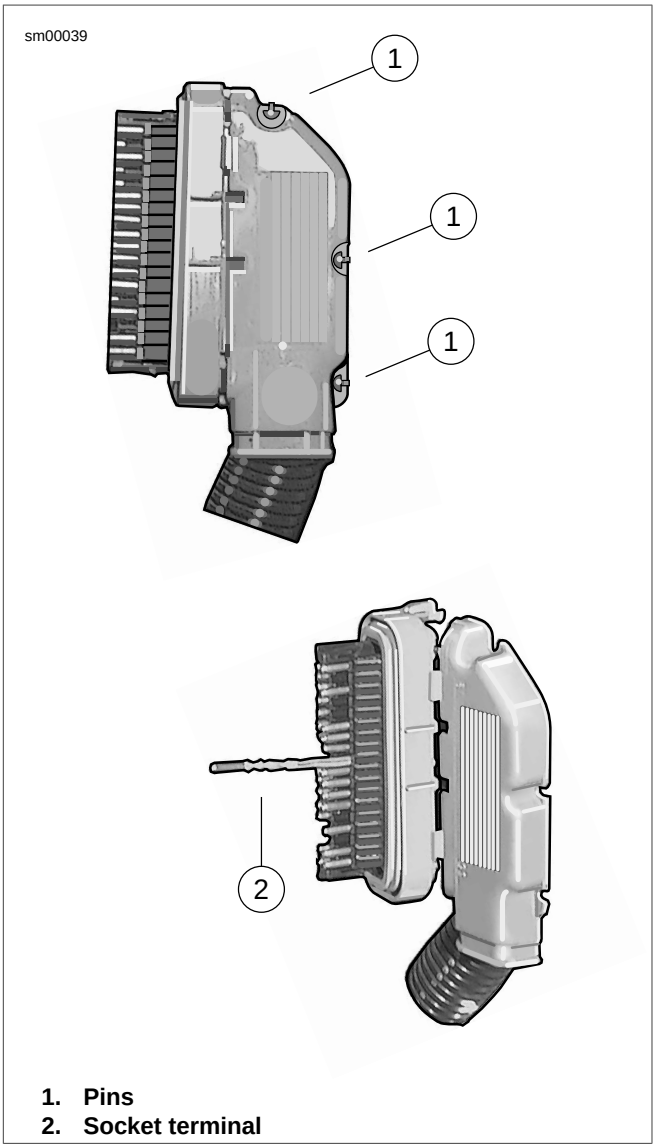

1. **Thumb lever**
2. **Latch**
3. **Catch (ECM)**

**Figure A-47. Packard 100W to ECM (Typical)**




1. **Latch**
2. **Secondary lock**
3. **Cable strap**
4. **Strain relief collar**
5. **Conduit**

**Figure A-48. Packard 100W Connector**




1. **Pins**
2. **Socket terminal**

**Figure A-49. Packard 100W Connector: Separate Halves of Socket Housing**

## PACKARD MICRO-64 CONNECTOR REPAIR

| PART NUMBER | TOOL NAME |
|---|---|
| HD-45928 | PACKARD MICRO-64 TERMINAL REMOVER |
| HD-45929 | PACKARD MICRO-64 TERMINAL CRIMPER |

### General

Packard Micro-64 connectors are frequently found on speedometers, tachometers and the ECM of Touring Models. For pin 73 of these ECMs, see A.12 PACKARD 150 METRI-PACK CONNECTORS.

### Separating Pin and Socket Housings

Bend back the external latches slightly and separate the pin and socket housings.

### Mating Pin and Socket Housings

Orient the wire lead colors and push the pin and socket housings of the connector together until the latches click.

### Removing Terminal

1. See Figure A-52. Locate the head of the secondary lock (1) on one side of the connector housing.
2. Insert the blade of a small screwdriver between the center ear of the lock and the connector housing and gently pry out lock. When partially removed, pull lock from connector housing.
3. Locate pin hole (2) between terminals on mating end of connector.
4. See Figure A-53. Obtain the PACKARD MICRO-64 TERMINAL REMOVER (Part No. HD-45928).
5. See Figure A-51. Push the adjacent terminals all the way into the connector housing and then insert tool into hole until it bottoms.
6. Leaving the tool installed, gently tug on wires to pull either one or both terminals from wire end of connector. Remove tool.




**Figure A-50. Packard Micro 64 Terminal Remover (HD-45928)**

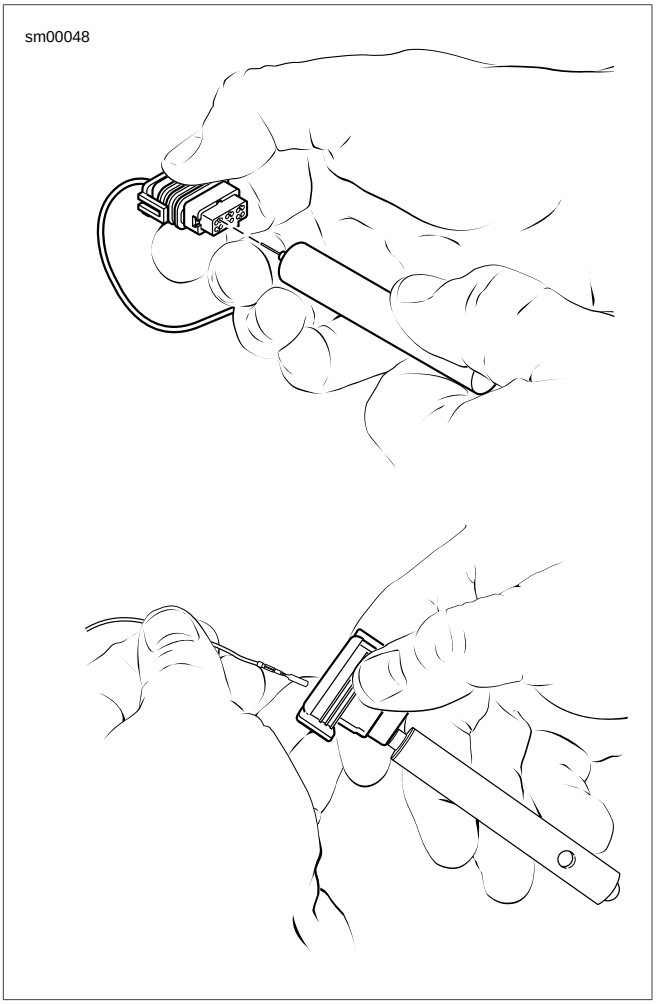



**Figure A-51. Packard Micro 64 Connector: Insert Tool and Remove Terminal**

### Installing Terminal

1. Insert terminal into its respective numbered chamber on wire end of connector. No special orientation of the terminal is necessary.

*NOTE*

*See Figure A-52. For wire location purposes, the corners of the socket housing are stamped (3) with the numbers 1, 6, 7 and 12, representing terminals 1-6 on one side, and 7-12 on the other.*

2. Bottom the terminal in the chamber and then gently tug on the wire to verify that it is locked in place.

*NOTE*

*Once the terminal is removed it may not lock in place when first reinstalled. Until the lock engages, move the terminal back and forth slightly while wiggling the lead.*

3. Since the terminal remover tool releases two terminals simultaneously, repeat step 2 on the adjacent terminal even if it was not pulled from the connector housing.

4. With the center ear on the head of the secondary lockpin facing the mating end of the connector, push secondary lock in until head is flush with the connector housing.

## Preparing Wire Leads for Crimping

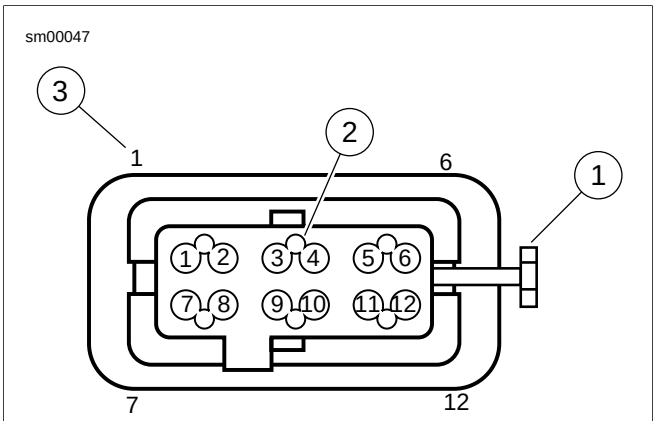
Strip lead removing 3.0 mm (1/8 in.) of insulation.

## Crimping Terminals

1. Inspect **new** socket terminal for bent or deformed contact and crimp tails. Replace as necessary.
2. See Figure A-54. Squeeze the handles of the PACKARD MICRO-64 TERMINAL CRIMPER (Part No. HD-45929) to cycle the tool to the fully open position (1).
3. Raise locking bar and barrel holder by pushing up on bottom tab with index finger (2).
4. With the crimp tails facing upward, insert terminal through locking bar into front hole in barrel holder (20-22 gauge wire) (3).
5. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails and the closed side of the terminal rests on the outer nest of the crimp tool.
6. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that wide pair of crimp tails squeeze bare wire strands, while the narrow pair folds over the insulation material.
7. Squeeze handle of crimp tool until tightly closed (4). Tool automatically opens when the crimping sequence is complete.
8. Raise locking bar and barrel holder to remove contact.

## Inspecting Crimps

Inspect the quality of the core and insulation crimps. Distortion should be minimal.




1. **Secondary lock**
2. **Pin hole**
3. **Stamped number**

**Figure A-52. Packard Micro 64 Connector: Housing**

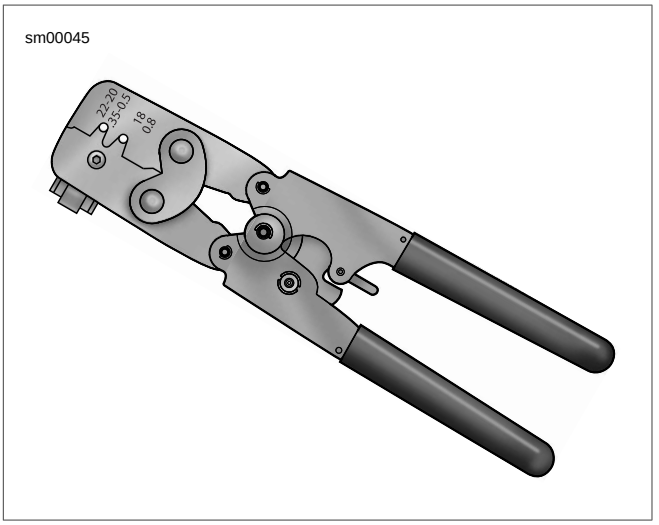
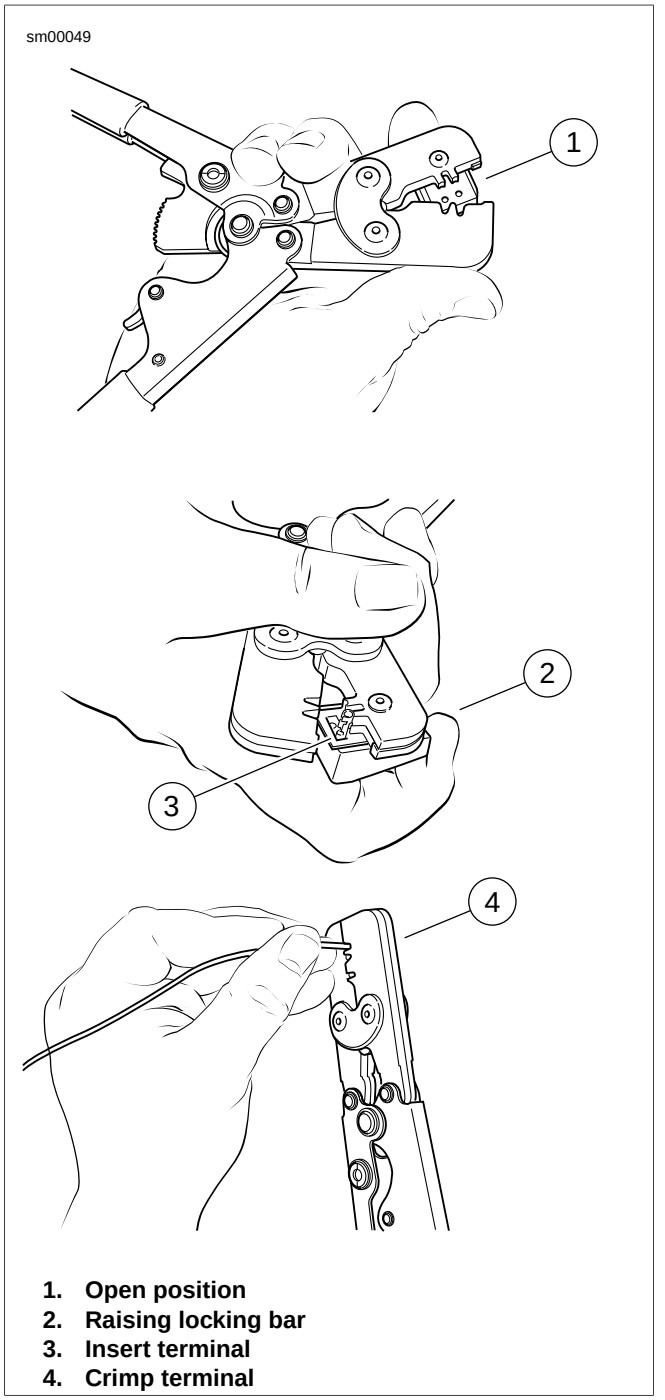



**Figure A-53. Packard Micro 64 Terminal Crimper (HD-45929)**




1. **Open position**
2. **Raising locking bar**
3. **Insert terminal**
4. **Crimp terminal**

**Figure A-54. Packard Micro 64 Connector: Terminal in Crimper**

## SEALED SPLICE CONNECTOR REPAIR

| PART NUMBER | TOOL NAME |
|---|---|
| HD-25070 | ROBINAIR HEAT GUN |
| HD-38125-8 | PACKARD CRIMPING TOOL |
| HD-39969 | ULTRA TORCH UT-100 |
| HD-41183 | HEAT SHIELD ATTACHMENT |

### General

Splice connectors and several OE ring terminal connectors use heat shrink covering to seal the connection.

### Preparing Wire Leads

*NOTE*

*If adjacent wires are to be spliced, stagger the splices so that the sealed splice connectors will not touch each other but are located at different positions along the length of the wires.*

1. Using a shop gauge, identify the gauge of the wire.
2. Match the wire gauge to a sealed splice connector by color and part number. Refer to Table A-5.
3. Using a wire stripper, cut and strip a length of insulation off the wire ends. Refer to Table A-5 for the strip length.

**Table A-5. Sealed Splice Connectors**

| WIRE GAUGE | COLOR | PART NO. | STRIP LENGTH |
|---|---|---|---|
| 18-20 (0.5-0.8 mm) | Red | 70585-93 | 9.5 mm (3/8 in.) |
| 14-16 (1.0-2.0 mm) | Blue | 70586-93 | 9.5 mm (3/8 in.) |
| 10-12 (3.0-5.0 mm) | Yellow | 70587-93 | 9.5 mm (3/8 in.) |

*NOTE*

*If any copper wire strands are cut off of the wire core, trim the end and strip the wire again in a larger gauge stripper.*

### Splicing Wire Leads

*NOTE*

*See Figure A-56. The connector is crimped twice - one side and then the other.*

1. See Figure A-55. Open the PACKARD CRIMPING TOOL (Part No. HD-38125-8) ratchet by squeezing the handles closed.
2. Match the connector color to the wire gauge crimp die in the jaws and insert one end of the sealed connector.
3. Gently squeeze the handles until the connector is held in the jaws.
4. See Figure A-56. Feed the stripped end of a wire into the connector until the wire stops inside the metal insert (1).
5. Squeeze the handles tightly closed to crimp the lead in the insert (2). The tool automatically opens when the crimping is complete.
6. Slide the connector to the other half of the metal insert. Insert the stripped wire lead (1) until it stops, and crimp the lead in the insert (2).

**⚠WARNING**

**Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)**

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
- Always keep hands away from tool tip area and heat shrink attachment.

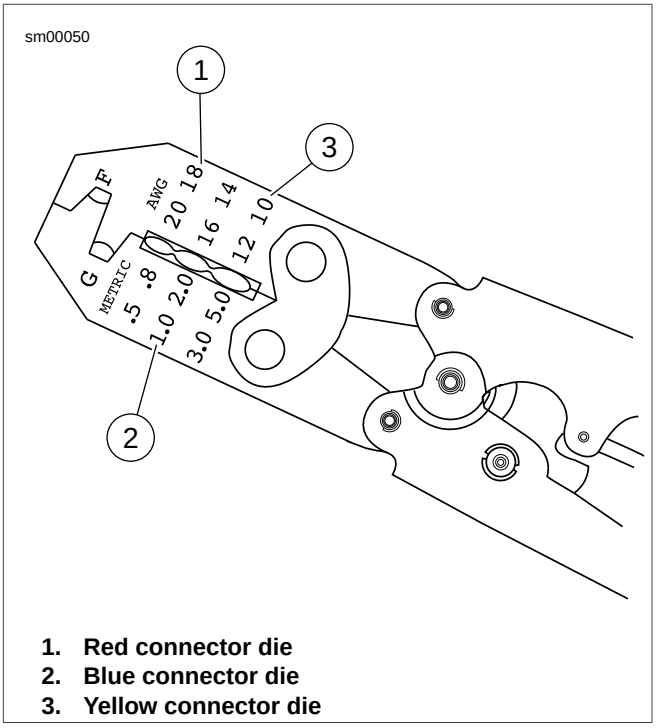
7. Use an ULTRA TORCH UT-100 (Part No. HD-39969), or a ROBINAIR HEAT GUN (Part No. HD-25070) with a HEAT SHIELD ATTACHMENT (Part No. HD-41183), to heat the connector from the center of the crimp (3) out to each end.

*NOTE*

*It is acceptable for the splice to rest against the heat shrink tool attachment.*

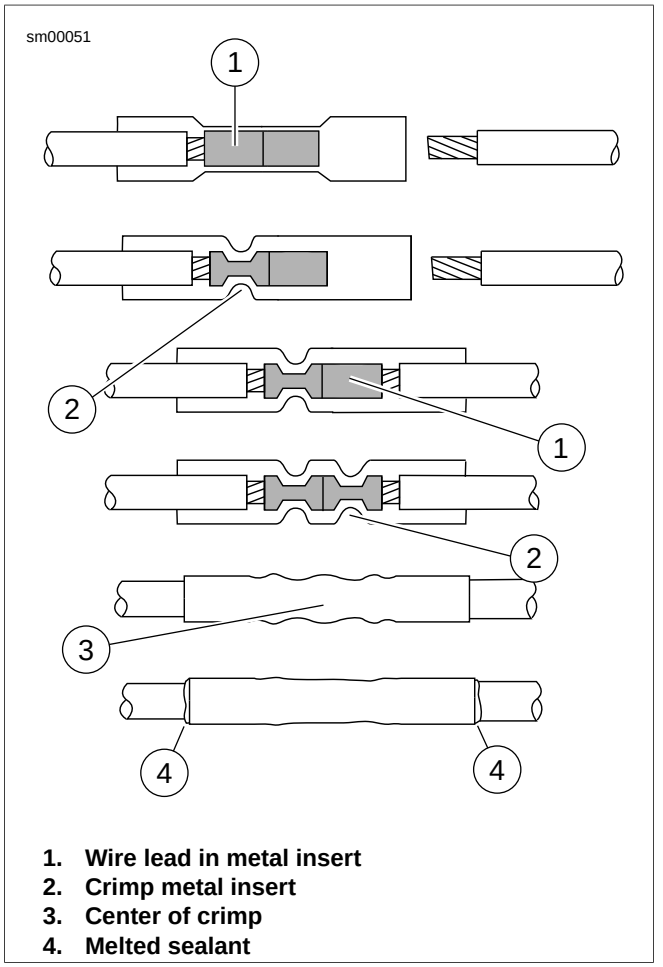
### Inspecting Seals

See Figure A-56. Allow the splice to cool and inspect the seal. The insulation should appear smooth and cylindrical. Melted sealant will have extruded out the ends (4) of the insulation.




1. **Red connector die**
2. **Blue connector die**
3. **Yellow connector die**

**Figure A-55. Packard Crimping Tool (HD-38125-8)**




1. **Wire lead in metal insert**
2. **Crimp metal insert**
3. **Center of crimp**
4. **Melted sealant**

**Figure A-56. Sealed Splice Connector**

**SUBJECT** **PAGE NO.**
B.1 CONNECTORS.....B-1
B.2 WIRING DIAGRAMS.....B-3

# NOTES

## CONNECTOR LOCATIONS

### Function/Location

Refer to Table B-1. On the motorcycle, a connector can be identified by its function and location.

### Place and Color

The place (number of wire cavities of a connector housing) and color of the connector can also aid identification.

### Connector Number

On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets.

### Repair Instructions

The repair instructions in this Service Manual are by connector type. Refer to Table B-1.

**Table B-1. VRSC Connector Locations**

| NO. | DESCRIPTION | TYPE | LOCATION |
|---|---|---|---|
| [5] | MAXIFUSE | Spade terminals | Under right side cover |
| [13] | Fuel level sensor | 3-place Molex | Below seat |
| [22] | Right hand controls | 6-place Molex | Under left side cover |
| [24] | Left hand controls and horn | 8-place Molex | Under left side cover |
| [29] | Position lamp (HDI) | 2-place Mini-Deutsch | Under left side cover |
| [30] | TSM/TSSM/HFSM | 12-place Deutsch | Under passenger seat |
| [31] | Front turn signals | 6-place Multilock | Under left side cover |
| [33] | Ignition switch | 3-place Packard | Back of ignition switch |
| [38] | Headlamp | 4-place Multilock | Back of headlamp |
| [39] | Instrument module | 12-place Packard | Under handlebar cover |
| [47] | Voltage regulator to stator | 3-place Packard | Back of voltage regulator |
| [61] | Fuse block | Spade terminals | Under passenger seat |
| [62] | Fuse block (start relay, fan relay) | Spade terminals | Under right side cover |
| [65] | Vehicle Speed Sensor (VSS) | 3-place Delphi | Rear of transmission case |
| [77] | Voltage regulator | 2-place Deutsch | Behind radiator cover |
| [78] | Electronic Control Module (ECM) | 36-place Packard | Under passenger seat |
| [79] | Crankshaft Position (CKP) sensor | 2-place Mini-Deutsch | Under left side cover |
| [80] | Manifold Air Pressure (MAP) sensor | 3-place Packard | Front intake passage |
| [83F] | Front plug-top ignition coil | 3-place Packard | On top of front cam cover |
| [83R] | Rear plug-top ignition coil | 3-place Packard | On top of rear cam cover |
| [84] | Front injector | 2-place Delphi | Throttle body |
| [85] | Rear injector | 2-place Delphi | Throttle body |
| [86] | Fuel pump | 4-place Packard | Top of fuel tank |
| [87] | Idle Air Control (IAC) | 4-place Delphi | Below air cleaner assembly |
| [88] | Throttle Position (TP) sensor | 3-place Delphi | Front of throttle body |
| [89] | Intake Air Temperature (IAT) sensor | 2-place Delphi | Under airbox |
| [90] | Engine Coolant Temperature (ECT) sensor | 2-place Delphi | Water pump housing |
| [91] | Data link connector | 4-place Deutsch | Under left side cover |
| [93] | Tail/stop lamp | 4-place Multilock | Under rear fender |
| [94] | Rear turn signal lamp | 6-place Multilock | Under rear fender |
| [95] | Purge solenoid | 2-place Packard | Below seat |
| [97T] | Cooling fan (top) | 2-place Multilock | Under left side cover |
| [97B] | Cooling fan (bottom) | 2-place Multilock | Under left side cover |
| [108] | Tachometer | 12-place Packard | Back of tachometer |

**Table B-1. VRSC Connector Locations**

| NO. | DESCRIPTION | TYPE | LOCATION |
|---|---|---|---|
| [120] | Oil pressure switch | Post terminal | On oil pressure switch, front of right crankcase |
| [121] | Rear stop lamp switch | Spade terminals | Behind transmission (without ABS)<br>Right side of ABS module (with ABS) |
| [122] | Horn | Spade terminals | Between cylinders, left side |
| [128] | Starter solenoid | 2-place Amp | Under left side cover |
| [131] | Neutral switch | Post terminals | Bottom rear of crankcase |
| [133] | Jiffy Stand Sensor (HDI) | 3-place Molex | Under left side cover |
| [137] | Rear oxygen sensor | 2-place Delphi | Along left side of frame, behind rear cylinder |
| [138] | Front oxygen sensor | 2-place Delphi | Under left side cover |
| [142] | Security siren (optional) | 3-place Delphi | Under passenger seat |
| [145] | Engine sensor harness connector | 8-place | Along frame |
| [166] | ABS module | 20-place Molex | Under right side cover |
| [167] | Front wheel speed sensor | 2-place Delphi | Behind radiator cover |
| [168] | Rear wheel speed sensor | 2-place Delphi | Along right side of frame, behind transmission |
| [201] | ABS diode pack | 4-place Deutsch | Under right side cover |
| [208] | Hands-Free Security Module (HFSM) antenna harness | 4-place Deutsch | Under passenger seat |
| [209] | Hands-Free Security Module (HFSM) antenna | 2-place Molex | Under passenger seat |
| [GND 1]<br>[GND 2]<br>[GND 3] | Harness ground (3) | Ring terminals | Front and rear cam covers |

## WIRING DIAGRAM INFORMATION

### Wire Color Codes

Wire traces on wiring diagrams are labeled with alpha codes. Refer to Table B-2.

**For Solid Color Wires:** See Figure B-1. The alpha code identifies wire color (3).

**For Striped Wires:** The code is written with a slash (/) between the solid color code and the stripe code (4). For example, a trace labeled GN / Y is a green wire with a yellow stripe.

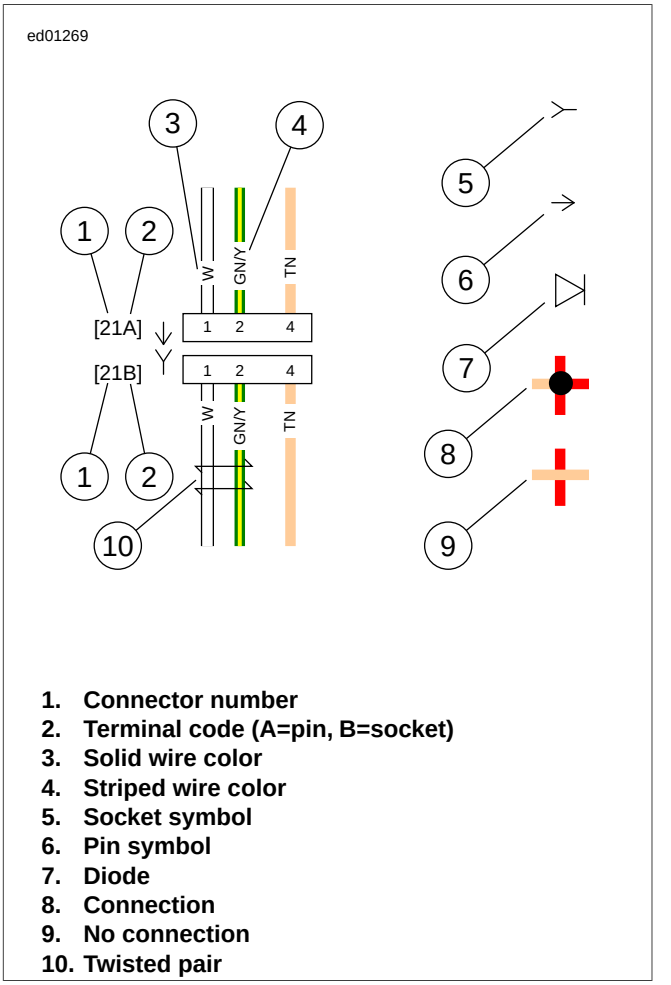
### Wiring Diagram Symbols

See Figure B-1. On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets (1). The letter (2) inside the brackets identifies whether the housing is a socket or pin housing.

**A=Pin:** The letter A after a connector number and the pin symbol (6) identifies a pin housing.

**B=Socket:** The letter B after a connector number and the socket symbol (5) identifies a socket housing.

Other symbols found on the wiring diagrams include the symbol for a diode (7), a symbol for a wire-to-wire connection (8), a symbol that verifies that no connection (9) between two wire traces exists and a symbol identifying two wires that are twisted together (10).




1. **Connector number**
2. **Terminal code (A=pin, B=socket)**
3. **Solid wire color**
4. **Striped wire color**
5. **Socket symbol**
6. **Pin symbol**
7. **Diode**
8. **Connection**
9. **No connection**
10. **Twisted pair**

**Figure B-1. Connector/Wiring Diagram Symbols (typical)**

**Table B-2. Wire Color Codes**

| ALPHA CODE | WIRE COLOR |
|---|---|
| BE | Blue |
| BK | Black |
| BN | Brown |
| GN | Green |
| GY | Grey |
| LGN | Light Green |
| O | Orange |
| PK | Pink |
| R | Red |
| TN | Tan |
| V | Violet |
| W | White |
| Y | Yellow |

Refer to the table below for wiring diagram information.

# Wiring Diagram List

| DIAGRAM | LOCATION |
|---|---|
| 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, MAIN HARNESS 1 of 2 | Figure B-2 |
| 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, MAIN HARNESS and CHARGING CIRCUIT 2 of 2 | Figure B-3 |
| 2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, MAIN HARNESS 1 of 2 | Figure B-4 |
| 2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, MAIN HARNESS and CHARGING CIRCUIT 2 of 2 | Figure B-5 |
| 2008 ALL VRSC DOM. and INT. MODELS, IGNITION CIRCUIT | Figure B-6 |
| 2008 ALL VRSC DOM. and INT. MODELS, STARTING CIRCUIT | Figure B-7 |
| 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, ABS CIRCUIT | Figure B-8 |
| 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, LIGHTING CIRCUIT | Figure B-9 |
| 2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, LIGHTING CIRCUIT | Figure B-10 |
| 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, HORN AND INSTRUMENT CIRCUIT | Figure B-11 |
| 2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, HORN AND INSTRUMENT CIRCUIT | Figure B-12 |
| 2008 ALL VRSC DOM. and INT. MODELS, SECURITY CIRCUIT | Figure B-13 |

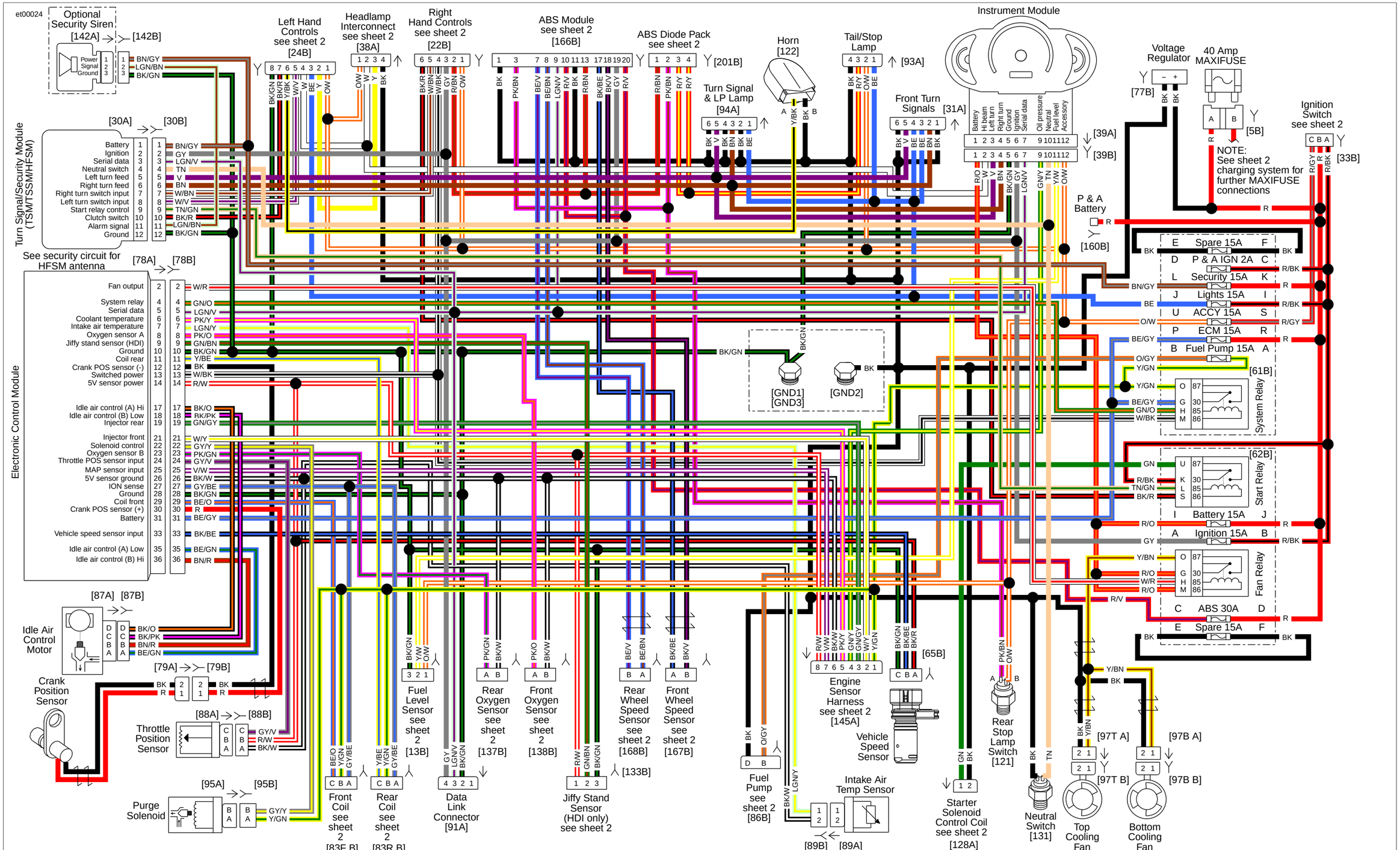



**Figure B-2. 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, MAIN HARNESS 1 of 2**

**Figure B-2.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, MAIN HARNESS 1 of 2**

**Figure B-2.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, MAIN HARNESS 1 of 2**

et00025

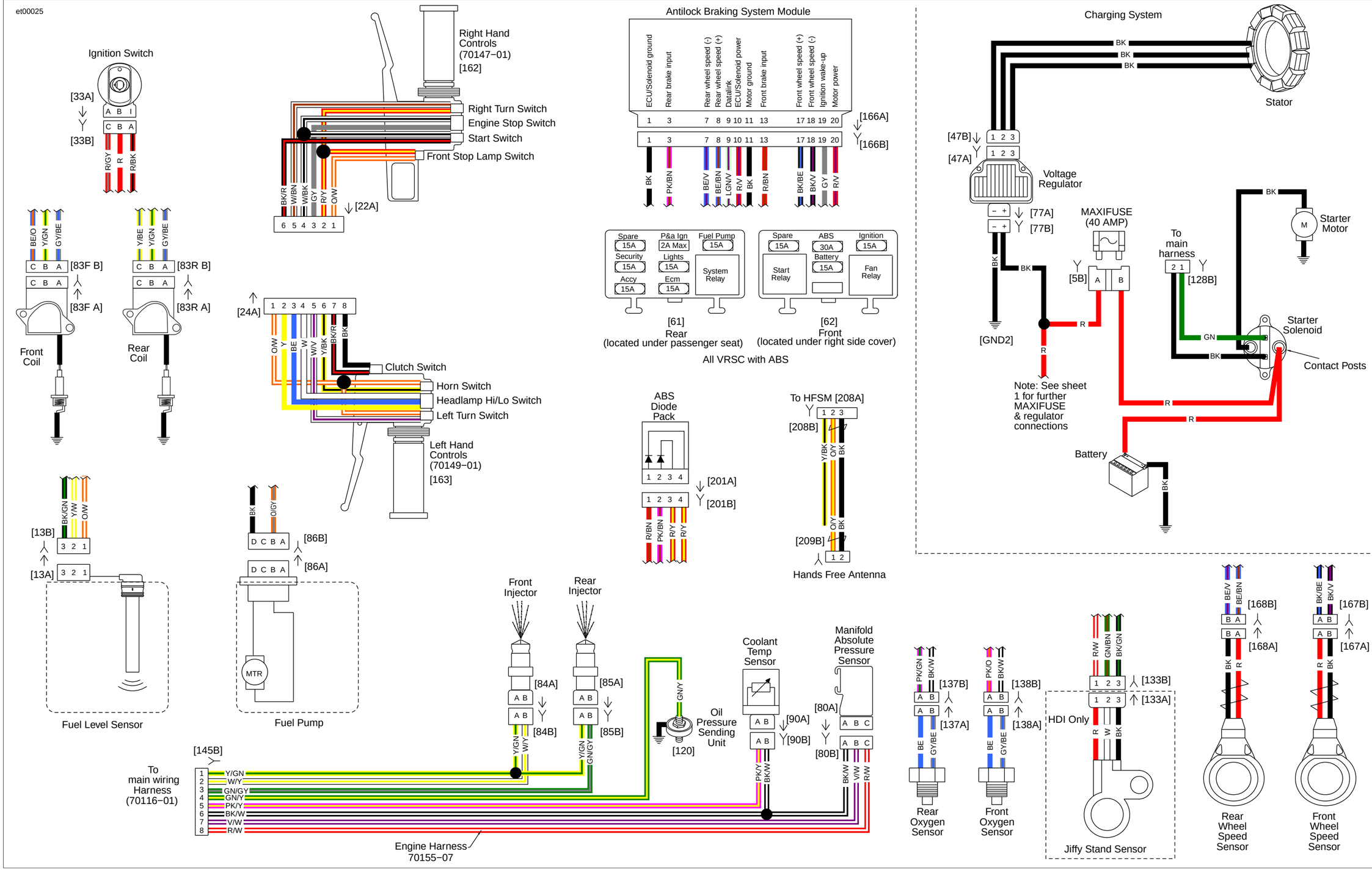



**Figure B-3. 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, MAIN HARNESS and CHARGING CIRCUIT 2 of 2**

**Figure B-3.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, MAIN HARNESS and CHARGING CIRCUIT 2 of 2**

**Figure B-3.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, MAIN HARNESS and CHARGING CIRCUIT 2 of 2**

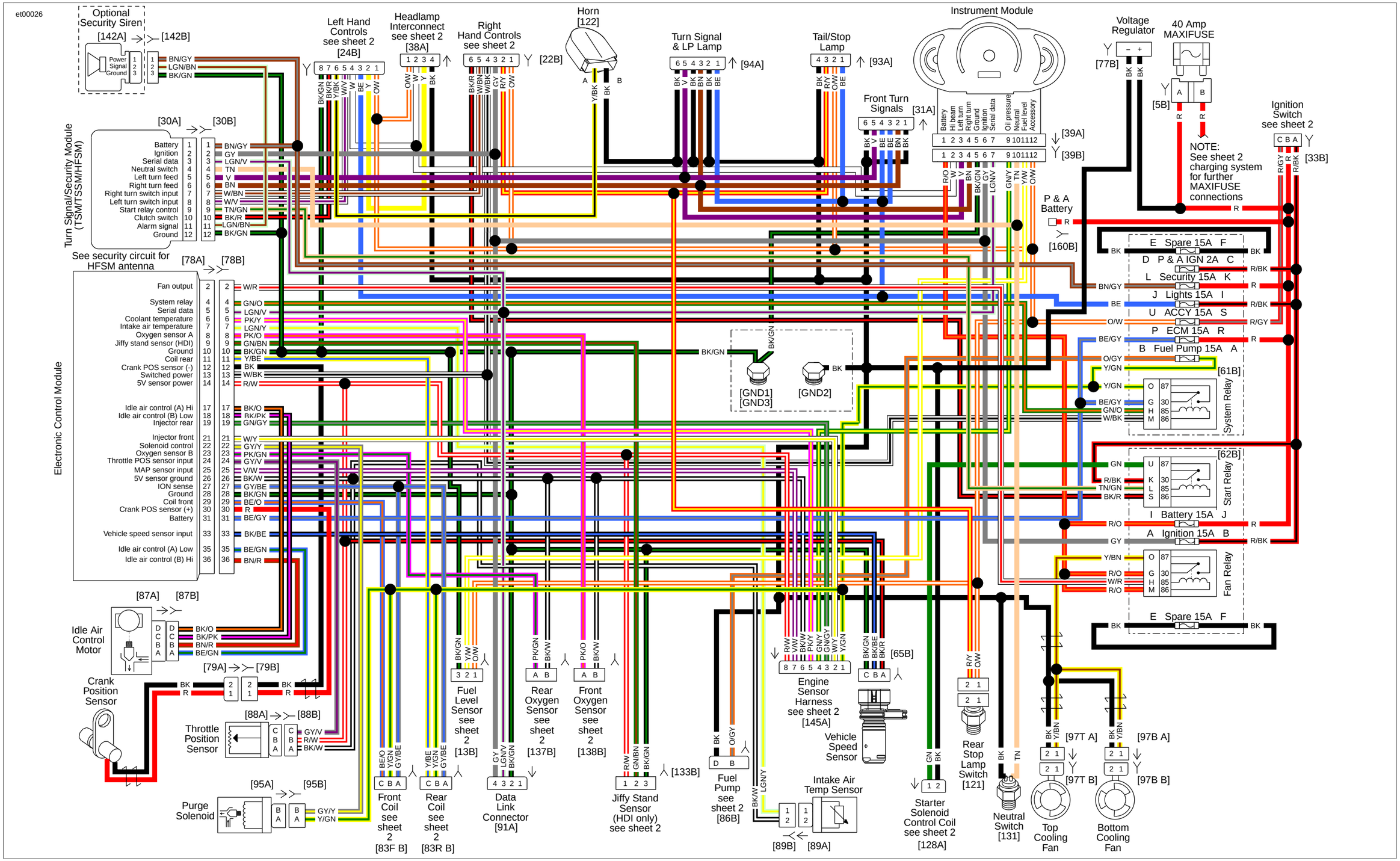



**Figure B-4. 2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, MAIN HARNESS 1 of 2**

**Figure B-4.**
**2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, MAIN HARNESS 1 of 2**

**Figure B-4.**
**2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, MAIN HARNESS 1 of 2**

et00027

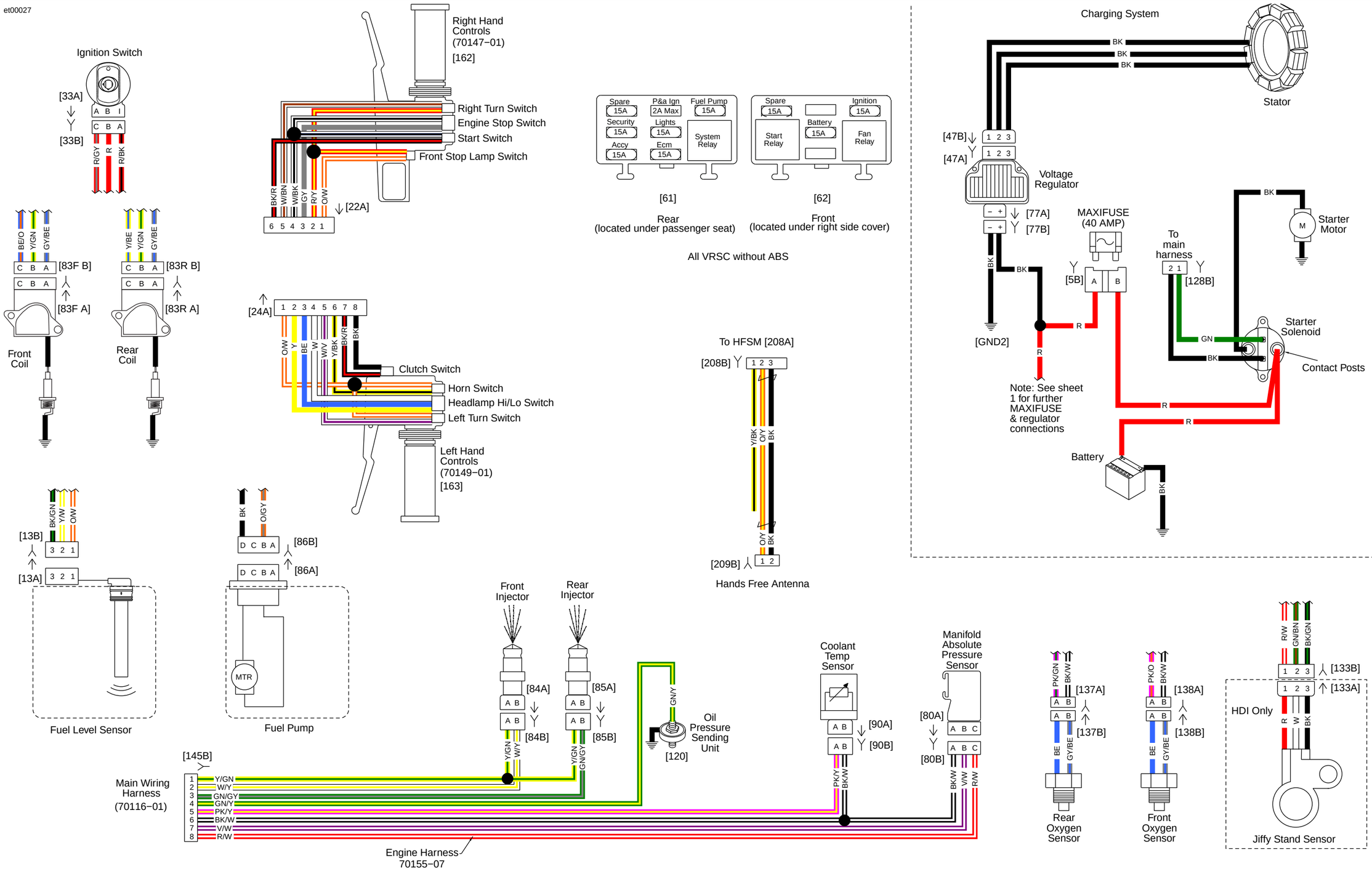



**Figure B-5. 2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, MAIN HARNESS and CHARGING CIRCUIT 2 of 2**

**Figure B-5.**
**2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, MAIN HARNESS and CHARGING CIRCUIT 2 of 2**

**Figure B-5.**
**2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, MAIN HARNESS and CHARGING CIRCUIT 2 of 2**

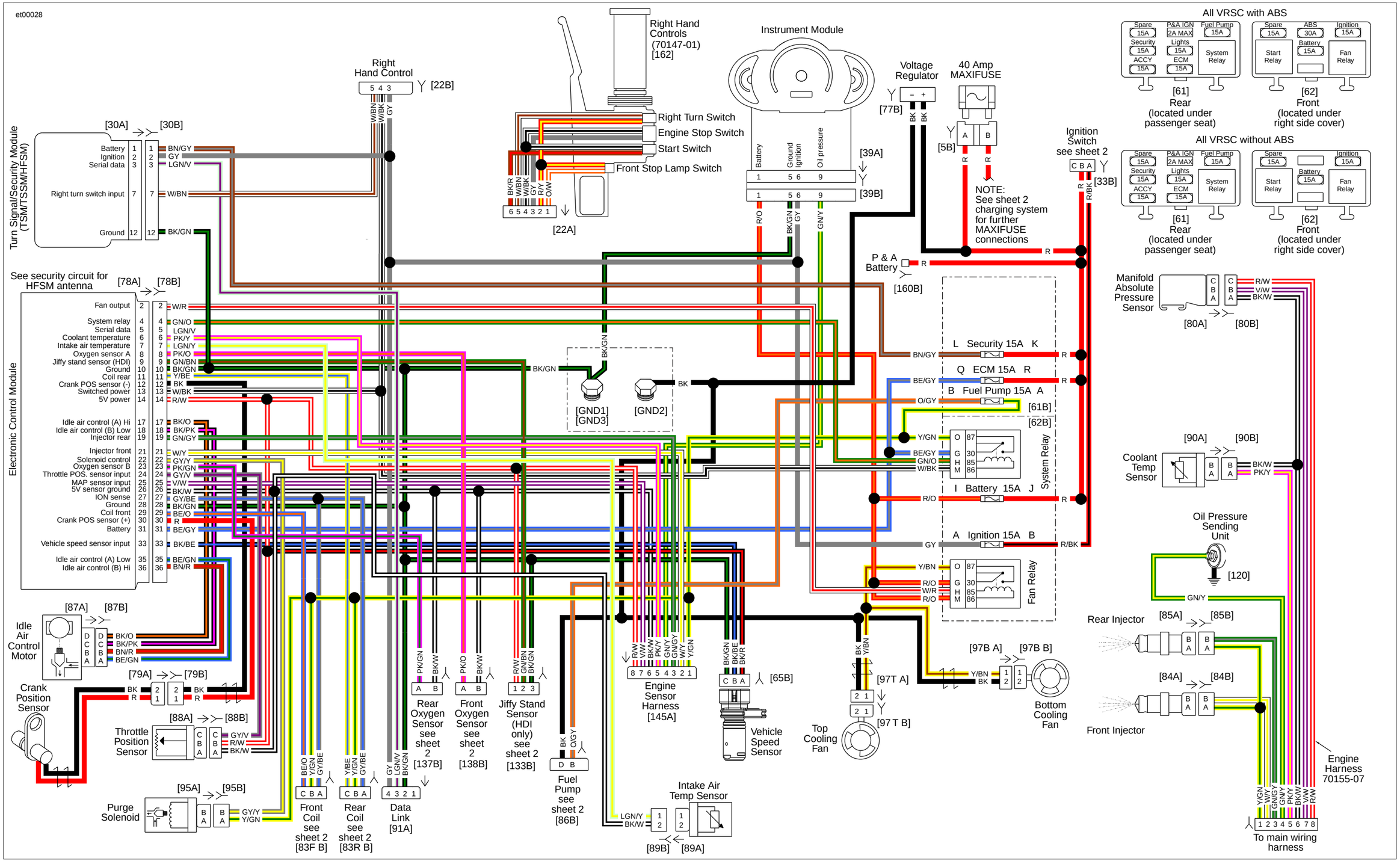



**Figure B-6. 2008 ALL VRSC DOM. and INT. MODELS, IGNITION CIRCUIT**

**Figure B-6.**
**2008 ALL VRSC DOM. and INT. MODELS, IGNITION CIRCUIT**

**Figure B-6.**
**2008 ALL VRSC DOM. and INT. MODELS, IGNITION CIRCUIT**

et00029

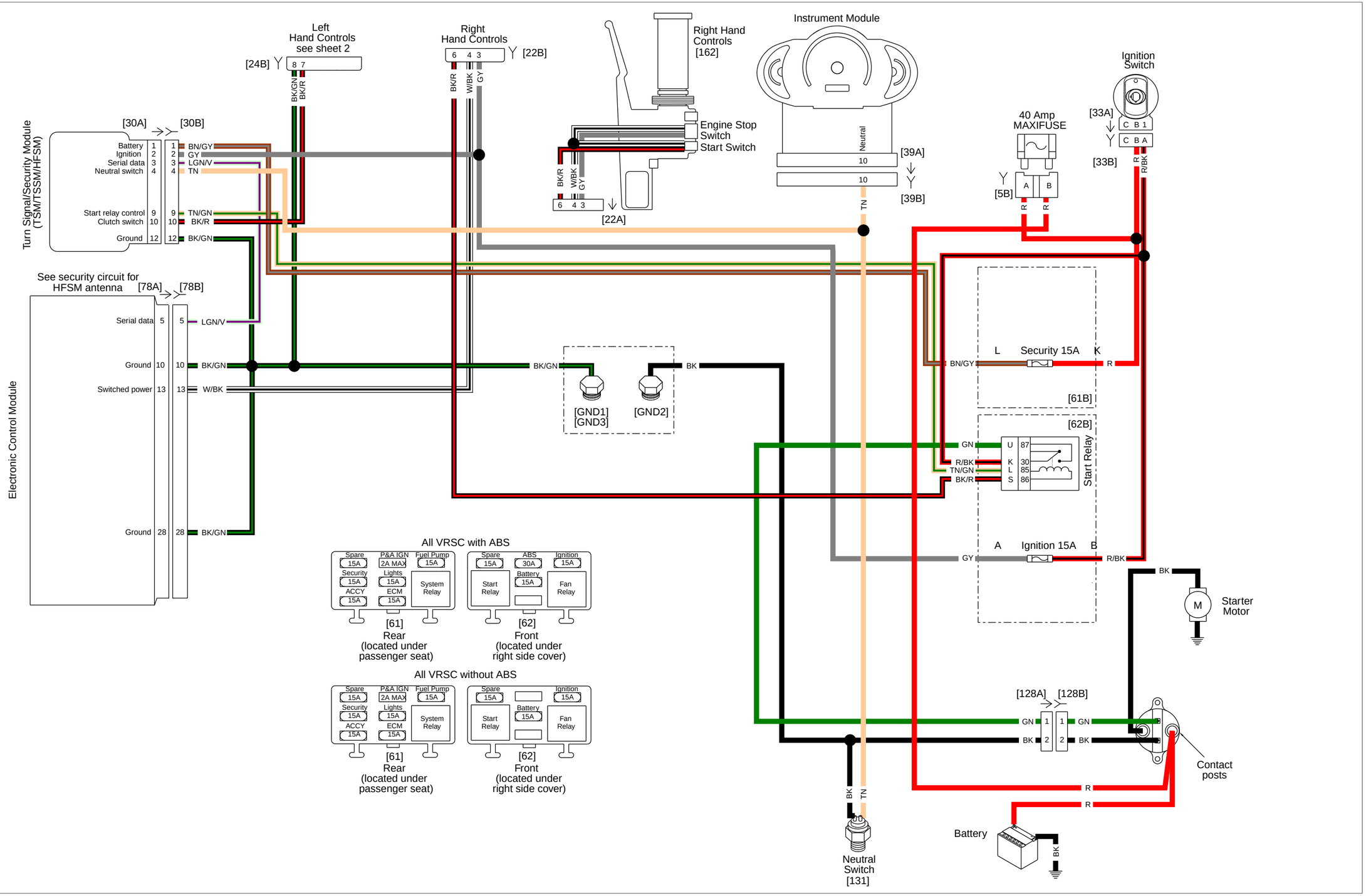



**Figure B-7. 2008 ALL VRSC DOM. and INT. MODELS, STARTING CIRCUIT**

**Figure B-7.**
**2008 ALL VRSC DOM. and INT. MODELS, STARTING CIRCUIT**

**Figure B-7.**
**2008 ALL VRSC DOM. and INT. MODELS, STARTING CIRCUIT**

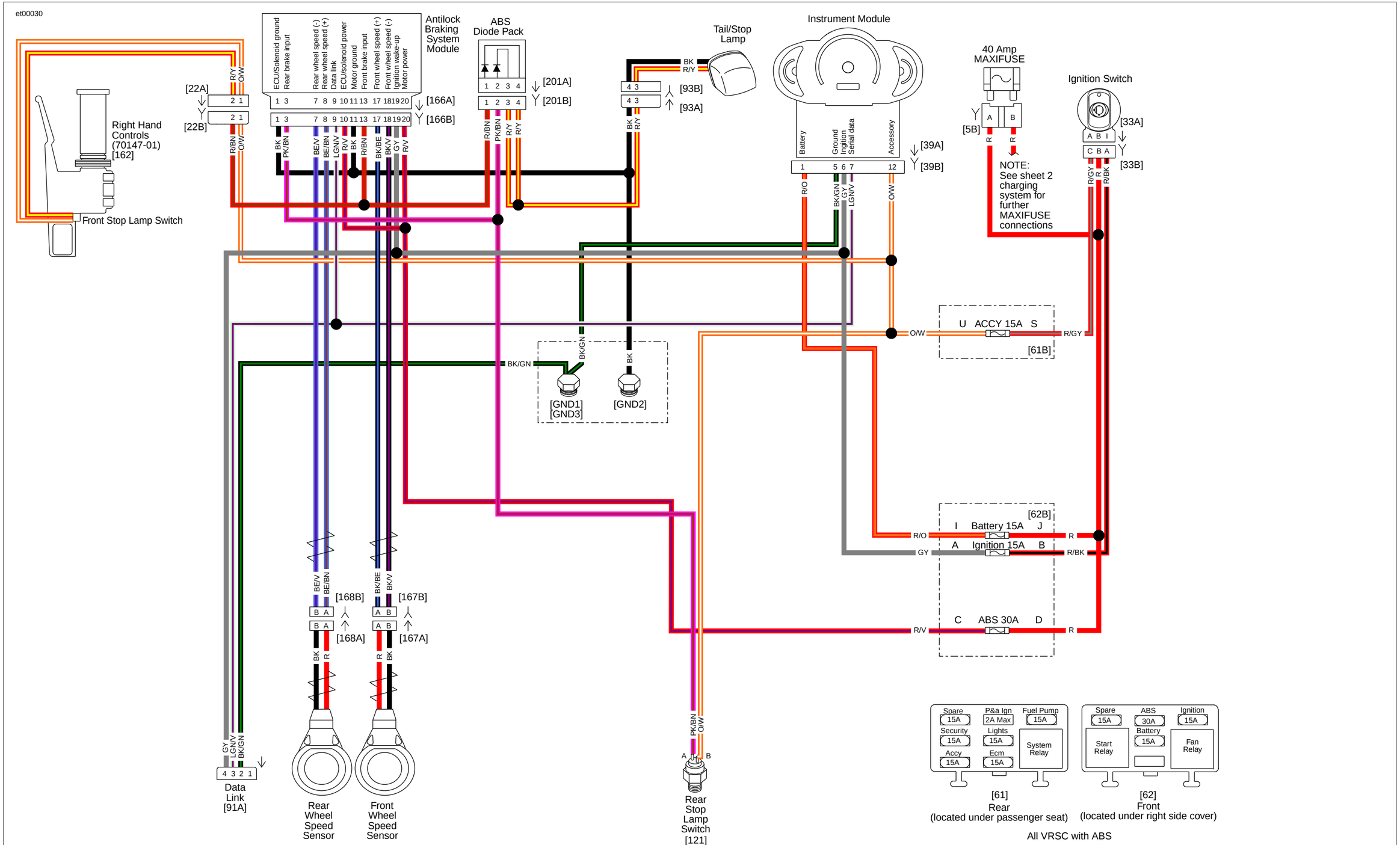



**Figure B-8. 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, ABS CIRCUIT**

**Figure B-8.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, ABS CIRCUIT**

**Figure B-8.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, ABS CIRCUIT**

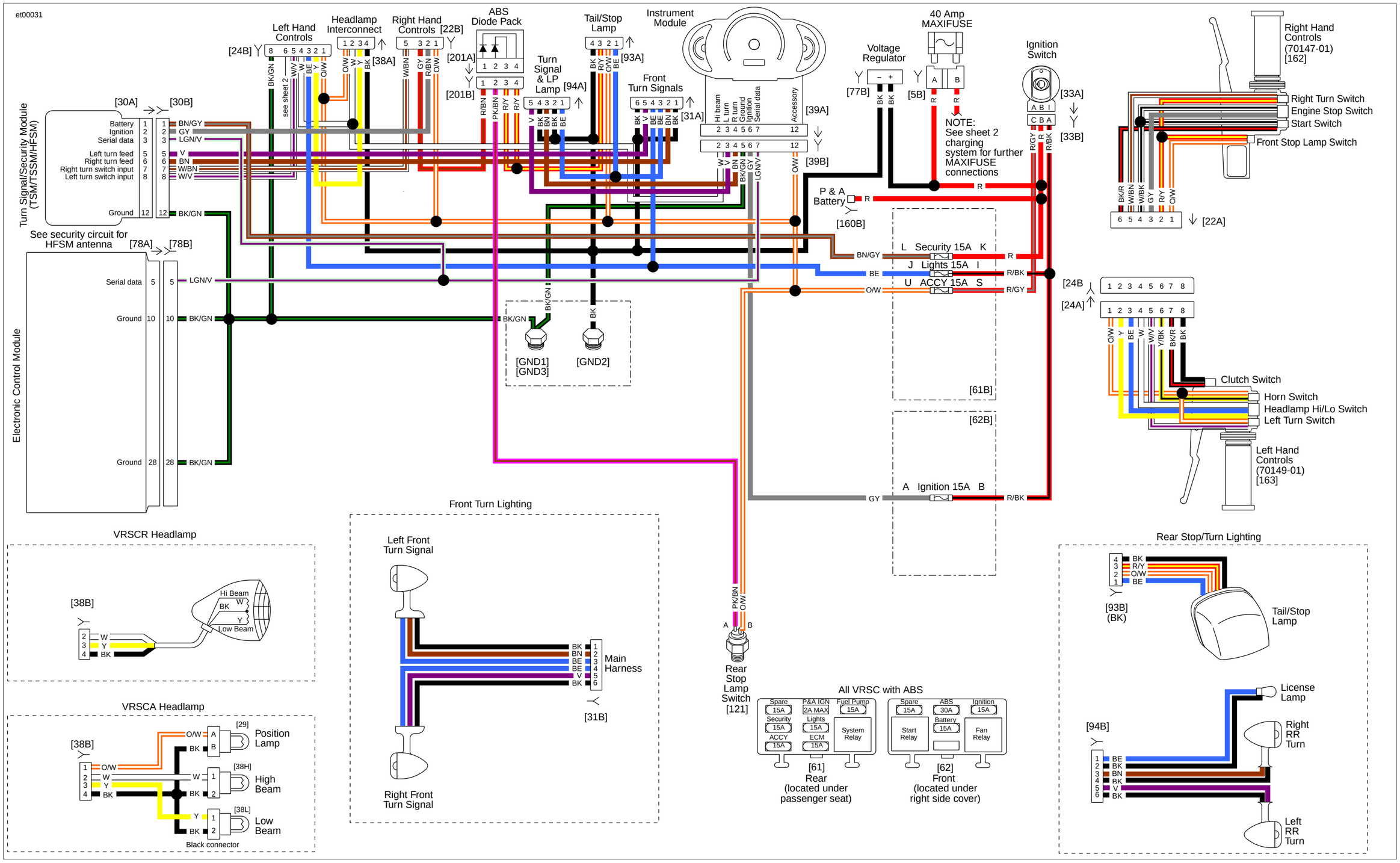



**Figure B-9. 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, LIGHTING CIRCUIT**

**Figure B-9.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, LIGHTING CIRCUIT**

**Figure B-9.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, LIGHTING CIRCUIT**

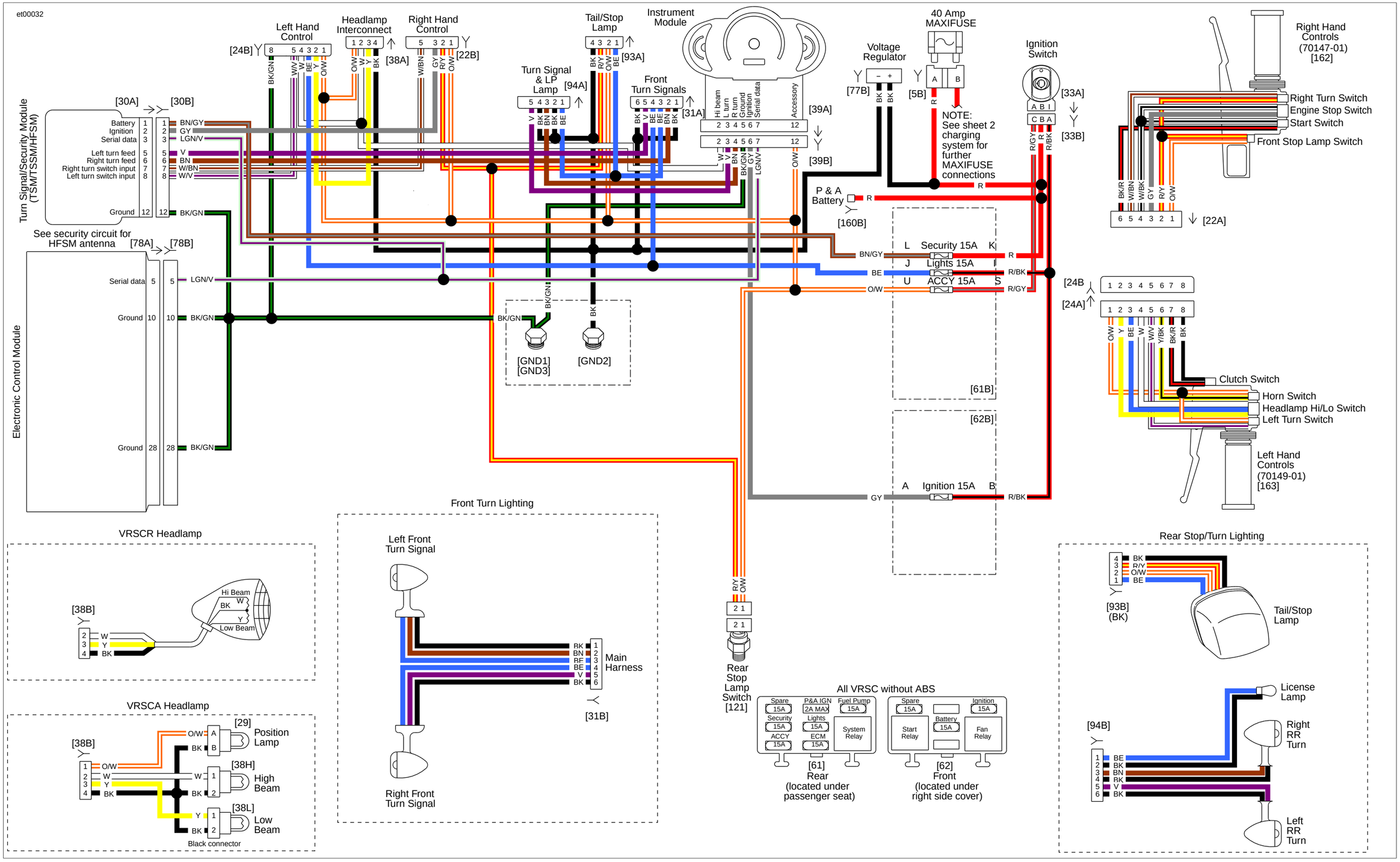



**Figure B-10. 2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, LIGHTING CIRCUIT**

**Figure B-10.**
**2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, LIGHTING CIRCUIT**

**Figure B-10.**
**2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, LIGHTING CIRCUIT**

et00033

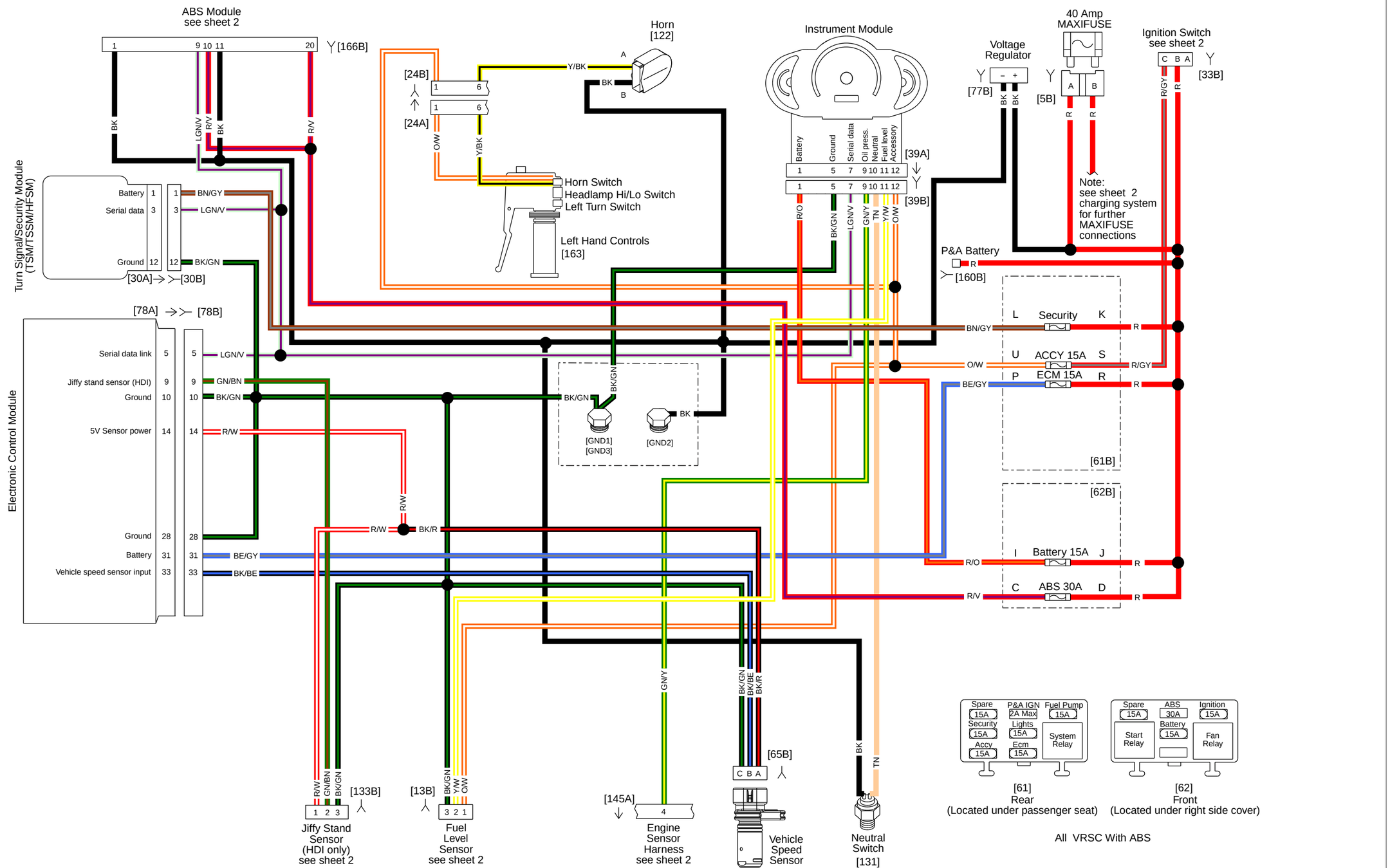



**Figure B-11. 2008 ALL VRSC DOM. and INT. MODELS WITH ABS, HORN AND INSTRUMENT CIRCUIT**

**Figure B-11.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, HORN AND INSTRUMENT CIRCUIT**

**Figure B-11.**
**2008 ALL VRSC DOM. and INT. MODELS WITH ABS, HORN AND INSTRUMENT CIRCUIT**

et00034

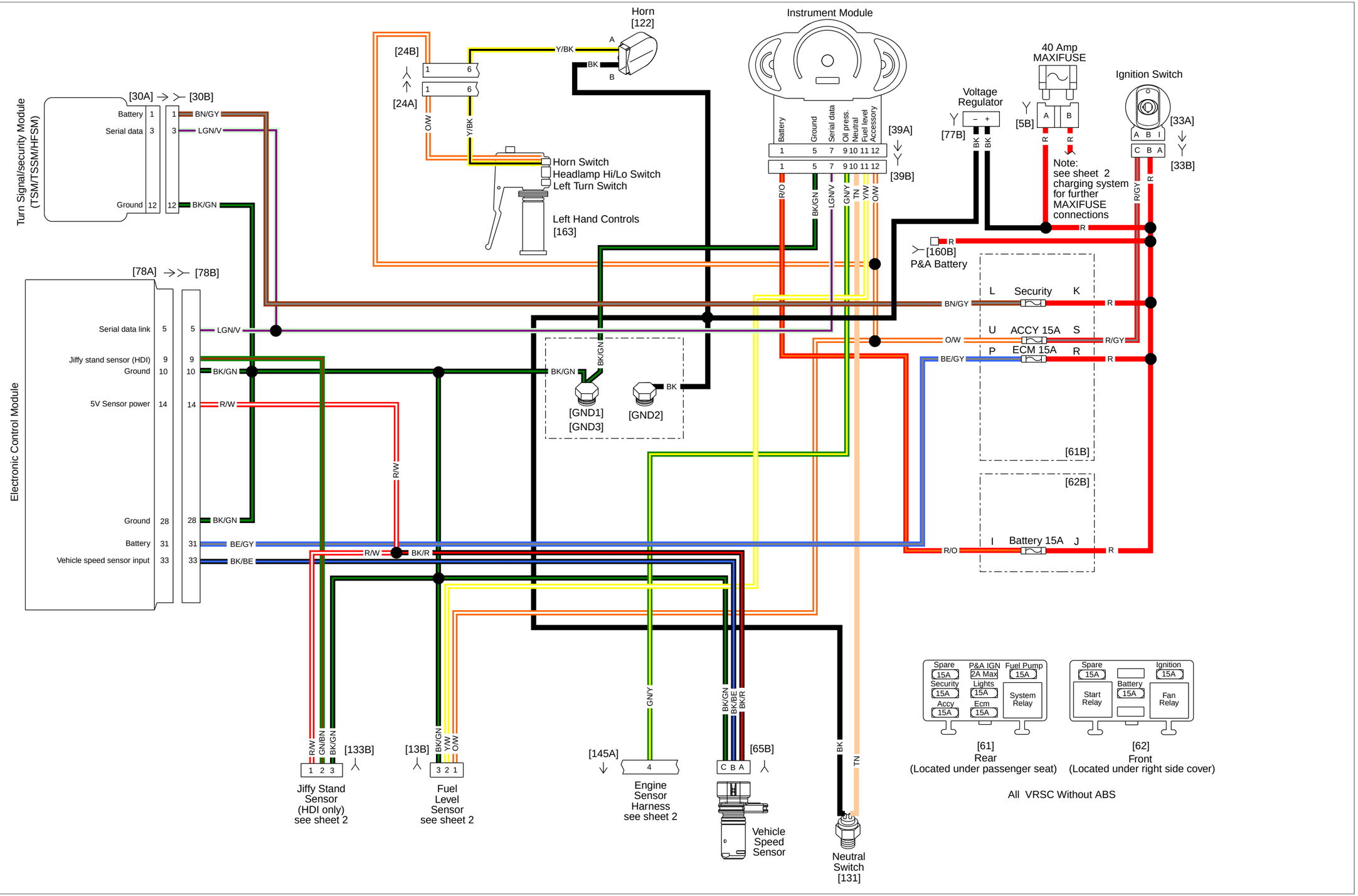



**Figure B-12. 2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, HORN AND INSTRUMENT CIRCUIT**

**Figure B-12.**
**2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, HORN AND INSTRUMENT CIRCUIT**

**Figure B-12.**
**2008 ALL VRSC DOM. and INT. MODELS WITHOUT ABS, HORN AND INSTRUMENT CIRCUIT**

et00035

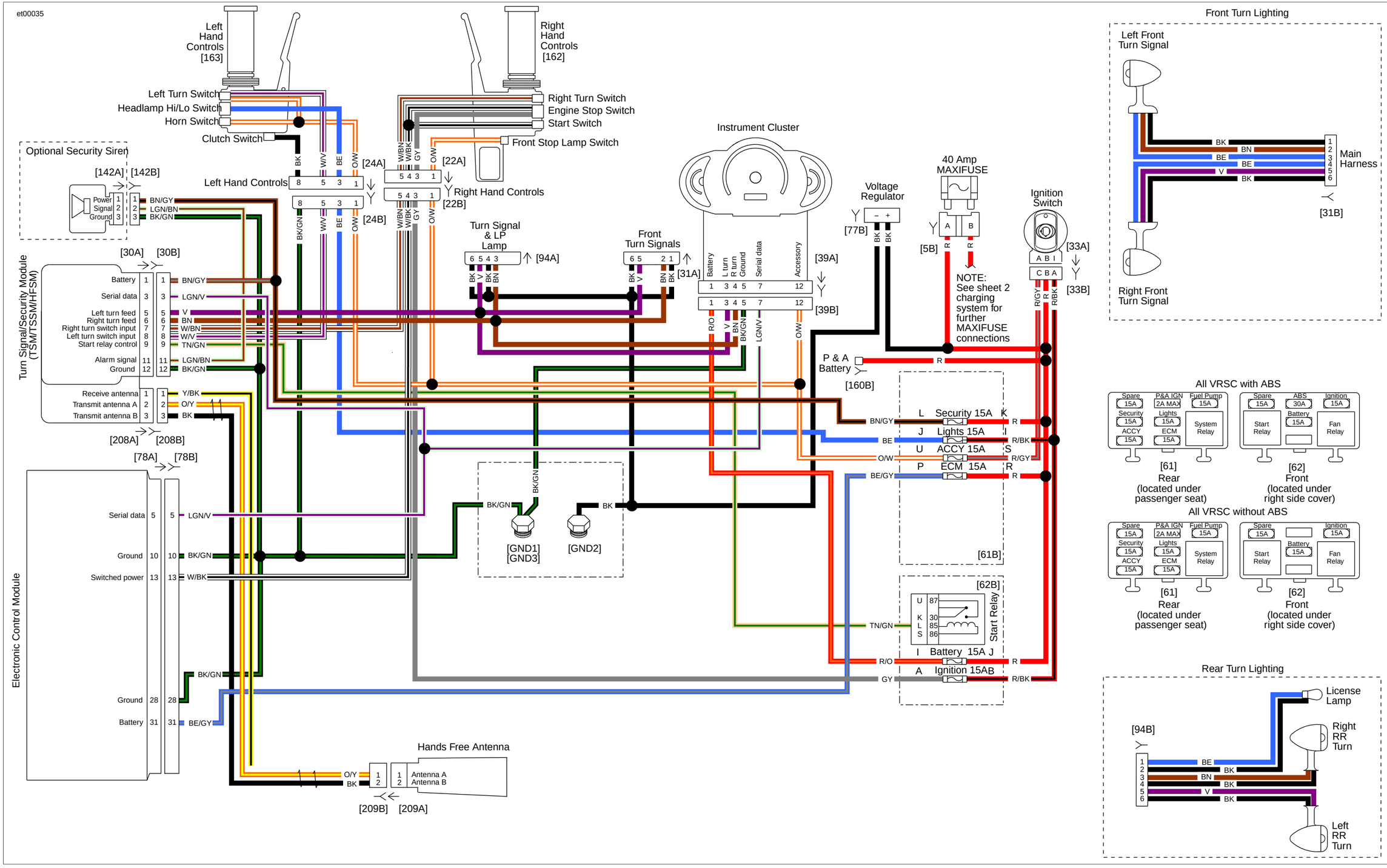



**Figure B-13. 2008 ALL VRSC DOM. and INT. MODELS, SECURITY CIRCUIT**

**Figure B-13.**
**2008 ALL VRSC DOM. and INT. MODELS, SECURITY CIRCUIT**

**Figure B-13.**
**2008 ALL VRSC DOM. and INT. MODELS, SECURITY CIRCUIT**

**SUBJECT** **PAGE NO.**
C.1 ABS MODULE.....C-1
C.2 WHEEL SPEED SENSOR.....C-3
C.3 ABS BRAKE LINES.....C-5

# NOTES

## REMOVAL

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

*NOTE*

*The ABS module consists of the hydraulic control unit (HCU) and the electronic control unit (ECU). These parts are not sold separately. Failure of either unit requires replacement of the ABS module.*

1. Remove Maxi-Fuse. See 8.4 MAXI-FUSE.
2. Remove airbox cover. See 1.5 AIR CLEANER AND EXHAUST SYSTEM.
3. Remove airbox.
4. Disconnect battery, remove all clipped connectors from battery caddy, disconnect and remove starter solenoid. See1.6 RADIATOR SIDE COVERS.
5. See Figure C-1. Remove battery and tray components from motorcycle.
   a. Remove positive (4) and negative (13) battery cables.
   b. Remove strap (1).
   c. Remove battery (6) from motorcycle.
   d. Remove left side battery caddy (5) and right side battery caddy (11).
   e. Remove fasteners (7) and (8) and remove battery tray (9) from motorcycle.
6. Remove radiator side panels and radiator shroud. See 1.6 RADIATOR SIDE COVERS.

*NOTE*

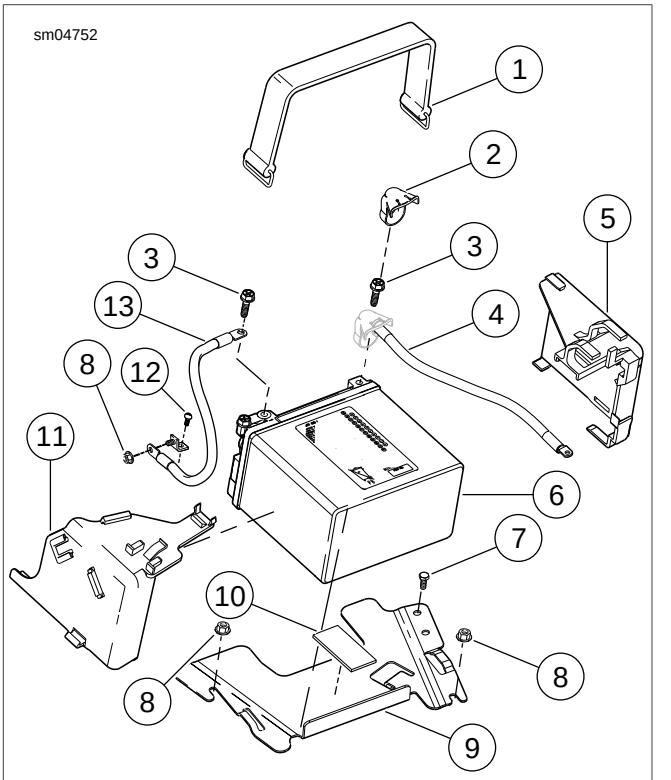
*Cover any remaining painted areas to protect them from contact with brake fluid during the removal and installation procedures.*

7. See Figure C-2 Remove top left mount bracket (3) from battery tray floor.
8. Evacuate brake fluid from brake system.
9. See Figure C-3 Disconnect ABS module electrical connector.

*NOTE*

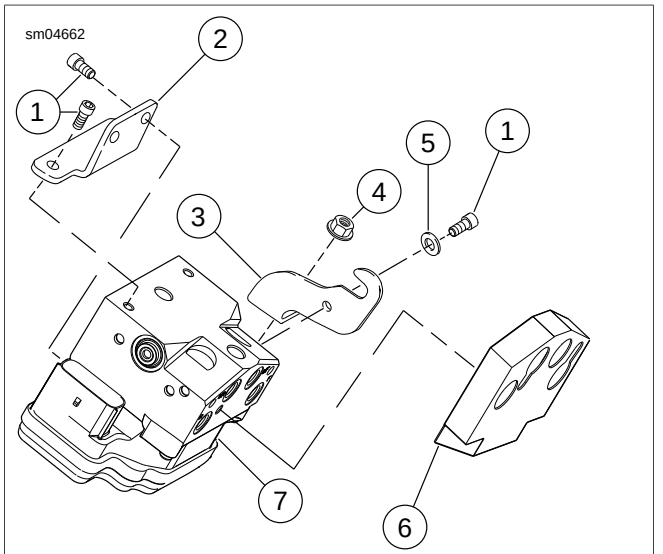
*Note location and routing of all brake lines as they attach to ABS module.*

10. Remove all brake lines from ABS module.
11. Remove screws (1) and ABS top mount bracket (2) from ABS module.
12. Remove ABS module from motorcycle.




1. **Strap**
2. **Boot**
3. **Terminal screw (2)**
4. **Positive cable to solenoid**
5. **Battery caddy (left side)**
6. **Battery**
7. **Screw**
8. **Nut (3)**
9. **Battery tray**
10. **Battery tray pad**
11. **Battery caddy (right side)**
12. **Screw**
13. **Negative cable**

**Figure C-1. Battery and Tray Components**




1. **Screw (5)**
2. **ABS top mount bracket**
3. **ABS left mount bracket**
4. **Nut**
5. **Washer**
6. **ABS module cover**
7. **ABS module**

**Figure C-2. ABS Module**

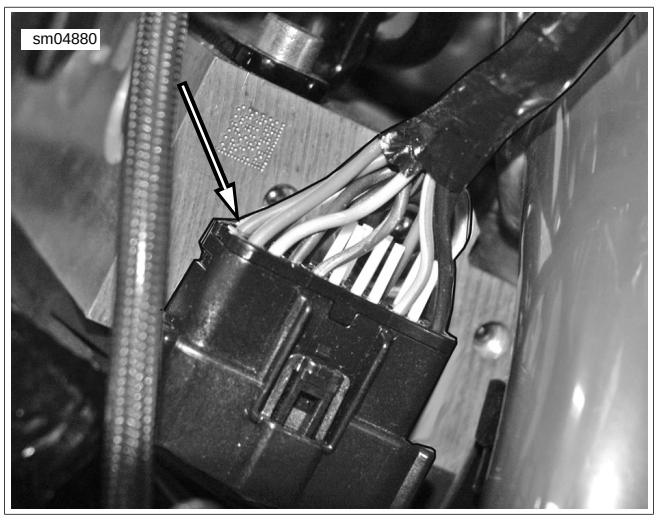



**Figure C-3. ABS Module Plug**

## INSTALLATION

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48650 | DIGITAL TECHNICIAN II |
| SNAP-ON BB200A | BASIC VACUUM BRAKE BLEEDER |

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Insert ABS module into head cavity of motorcycle frame. See Figure C-2.
2. Loosely install all ABS module fasteners. Do not tighten fasteners at this time.

*NOTE*

*Connect brake lines to ABS module at correct ports exactly as noted upon disassembly.*

3. Using **new** copper washers, attach brake lines to ABS module at correct ports exactly as noted upon disassembly. Tighten banjo bolts to 17-20 Nm (12.5-14.7 ft-lbs).
4. Final tighten ABS module fasteners to 4-6 Nm (35-53 **in-lbs**).
5. Install battery tray components and battery. See Figure C-1.
   a. Insert battery tray (9) into frame.
   b. Install battery tray with nuts and fastener as shown. Tighten fasteners to 6-10 Nm (53-88 **in-lbs**).
   c. Install left side battery caddy (5), right side battery caddy (11), battery (6) and strap (1).
   d. Install battery cables.
   e. Connect ABS module plug to ABS module. See Figure C-3.
6. Install starter solenoid to battery tray. See 5.5 STARTER SOLENOID.
7. Connect starter solenoid cables and wire.
8. Install all clipped connectors to their original positions on battery tray.
9. Fill and bleed air from brake system.
10. Install airbox and airbox cover.
11. Install Maxi-Fuse.
12. Obtain BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A) or equivalent tool. Add brake fluid and bleed brake system.
13. Connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and confirm that brake system is both properly connected and bled.

## FRONT WHEEL SPEED SENSOR

### Removal

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove Maxi-Fuse.See 8.4 MAXI-FUSE.
2. Remove both radiator side covers. See 1.6 RADIATOR SIDE COVERS.
3. Remove axle nut per procedure and slide front axle out far enough for wheel speed sensor to be removed from position. See 2.24 FRONT WHEEL.
4. Remove ABS sensor cable clip (1) from bracket (2). See Figure C-6.
5. Locate hose clips and disconnect sensor cable from brake hose. See Figure C-5.
6. Disconnect ABS connector and remove wheel speed sensor from motorcycle. See Figure C-4.

### Installation

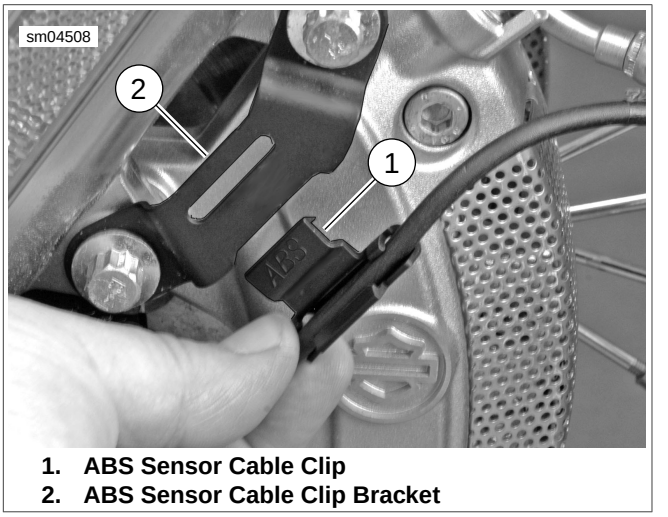
**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

*NOTE*

- *Never pull wheel speed sensor cable tight or use to retain wheel, axle or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

1. Install wheel speed sensor, slide front axle into place and pivot wheel speed sensor upward until tab stops sensor on fork leg.
2. Tighten front axle nut according to procedure. See 2.24 FRONT WHEEL.
3. Install ABS sensor clip as shown. See Figure C-6.
4. Connect ABS wheel speed sensor connector. See Figure C-4.
5. Install ABS cable clips as shown. See Figure C-5.
6. Install both radiator side covers. See 1.6 RADIATOR SIDE COVERS.
7. Install Maxi-Fuse. See 8.4 MAXI-FUSE.




1. **ABS Sensor Cable Clip**
2. **ABS Sensor Cable Clip Bracket**

**Figure C-4. ABS Sensor Cable Clip**

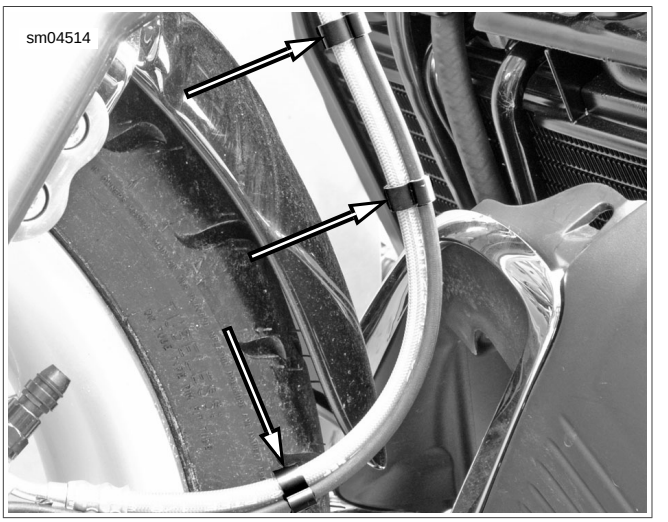



**Figure C-5. ABS Sensor Cable to Brake Hose Clips**

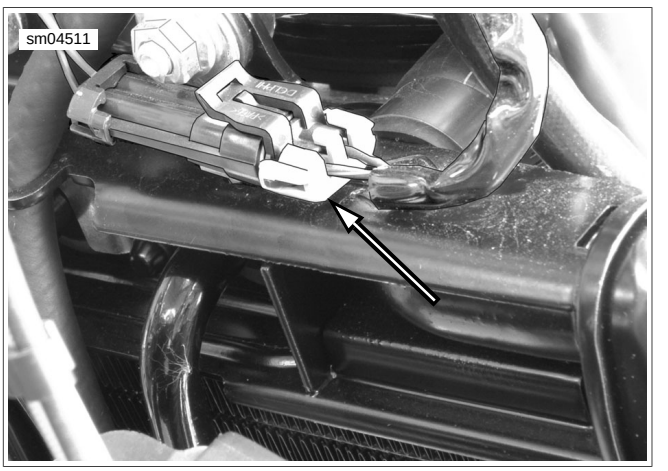



**Figure C-6. Front ABS Connector Location**

## REAR WHEEL SPEED SENSOR

### Removal

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. See 8.4 MAXI-FUSE. Remove Maxi-Fuse.

*NOTE*

*Note routing of all cable ties and clips before removal. Install cable ties and clips in exact locations as removed.*

2. See 2.27 REAR WHEEL. Remove axle nut per procedure and slide axle out far enough for wheel speed sensor to be removed from position.
3. See Figure C-7. Locate hose clips and disconnect sensor cable from brake hose.
4. See Figure C-8. Disconnect ABS connector and remove wheel speed sensor from motorcycle.

### Installation

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

*NOTE*

- *Never pull wheel speed sensor cable tight or use to retain wheel, axle or other components.*
- *Always keep wheel speed sensor (and ABS encoder bearing) away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*

1. See Figure C-9. Install wheel speed sensor, slide axle into place and pivot wheel speed sensor upward until locator stops sensor from moving further.
2. See 2.27 REAR WHEEL. Tighten axle and verify belt tension according to procedure.
3. See Figure C-8. Mate ABS wheel speed sensor connector.
4. See Figure C-7. Install ABS cable clips as shown.
5. See 8.4 MAXI-FUSE. Install Maxi-Fuse.

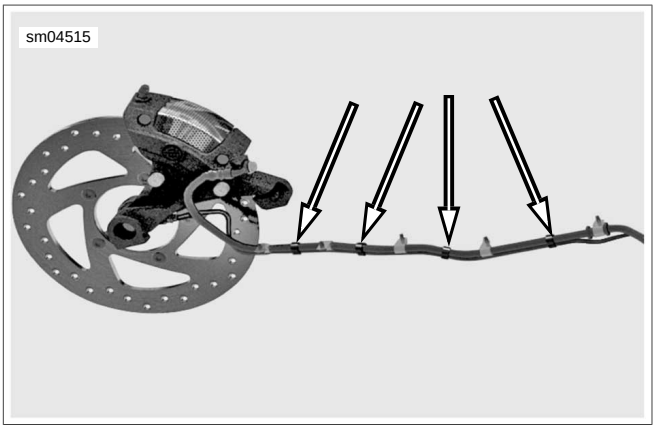



**Figure C-7. Rear ABS Sensor Cable to Brake Hose Clips**

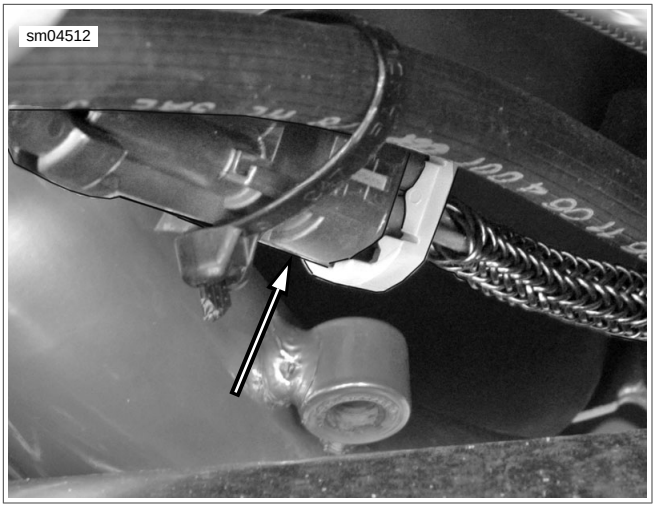



**Figure C-8. Rear ABS Connector Location**




**Figure C-9. ABS Sensor Locator**

## FRONT MASTER CYLINDER TO ABS MODULE

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48650 | DIGITAL TECHNICIAN II |
| SNAP-ON BB200A | BASIC VACUUM BRAKE BLEEDER |

### Removal

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove side covers.
2. See 8.4 MAXI-FUSE. Remove Maxi-Fuse.
3. See 1.5 AIR CLEANER AND EXHAUST SYSTEM. Remove air box cover assembly.
4. See 1.9 BATTERY MAINTENANCE. Disconnect and remove battery.
5. Remove starter solenoid from clip on plastic battery tray and remove plastic battery tray from motorcycle.

*NOTE*

*Cover any remaining painted areas to protect them from contact with brake fluid during the removal and installation procedures.*

6. Drain front brake system.

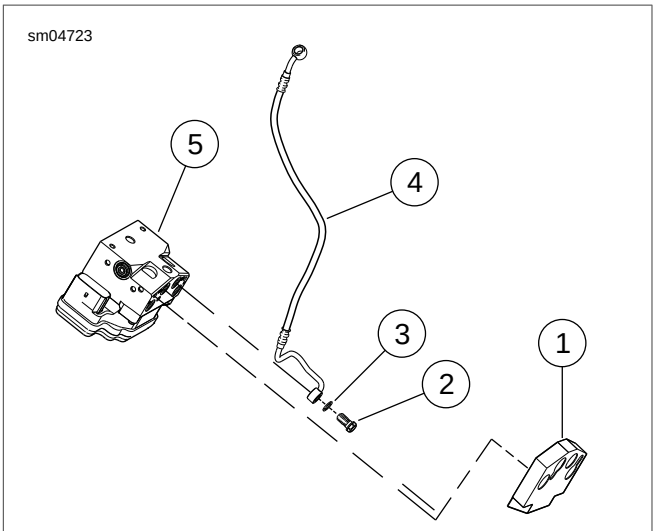
*NOTE*

*Note location and routing of brake line prior to removal.*

7. See Figure C-10. Remove banjo bolt to release brake line from MF port of ABS module. Discard washers.
8. Loosen ABS module fasteners to allow brake line clearance during disassembly.
9. Remove banjo bolt (2) to release brake line from master cylinder. Discard washers (3).
10. Remove brake line (4) from motorcycle, using caution to avoid spilling any residual brake fluid on finished surfaces.

### Installation

1. Route **new** brake line as original brake line was routed.
2. Install lower end of brake line to ABS module with banjo bolt and **new** washer.
3. Tighten banjo bolt to master cylinder to 17-20 Nm (12.5-14.7 ft-lbs).
4. Install upper end of brake line to front master cylinder with banjo bolt and **new** washers.
5. Tighten banjo bolt to ABS module to 17-20 Nm (12.5-14.7 ft-lbs)
6. Tighten ABS module fasteners to 4-6 Nm (35-53 **in-lbs**)
7. Install battery tray components; install and connect battery.
8. Install Maxi-Fuse.
9. Install side covers.
10. Obtain BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A) or equivalent tool. Add brake fluid and bleed front brake system.
11. Connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and confirm that front brake system is both properly connected and bled.




1. **ABS module cover**
2. **Bolt**
3. **Washer**
4. **Front master cylinder to ABS module brake line**
5. **ABS module**

**Figure C-10. Front Master Cylinder to ABS Module Brake Line**

## ABS MODULE TO FRONT BRAKE CALIPERS

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48650 | DIGITAL TECHNICIAN II |
| SNAP-ON BB200A | BASIC VACUUM BRAKE BLEEDER |

### Removal

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove Maxi-Fuse. See 8.4 MAXI-FUSE.
2. Remove left side cover.

*NOTE*

*Cover any exposed painted areas to protect them from contact with brake fluid during the removal and installation procedures.*

3. Drain front brake system.

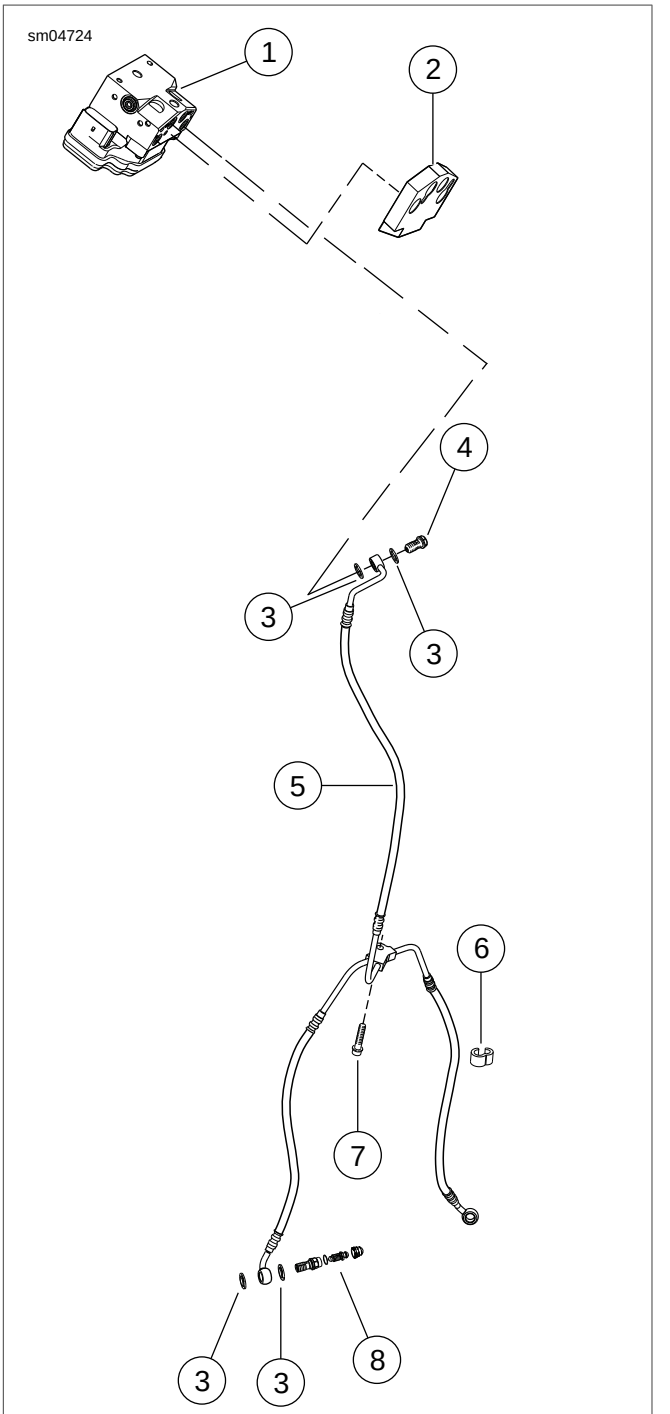
*NOTE*

*Note position and routing of brake lines, clips and wire ties prior to removal.*

4. Remove clips (6) from brake hose/ABS sensor cables.
5. Remove wire ties.
6. See Figure C-11. Remove banjo bolt (4) to release brake line from F port of ABS module. Discard washers (3).
7. Remove complete bleeder screw assemblies (8) to release brake lines from front calipers. Discard washers (3).
8. Remove screw (7) and remove brake line assembly from motorcycle.

## Installation

1. Route **new** brake line as original brake line was routed.
2. Install lower end of brake line (5) to calipers using bleeder screw assemblies (8) and **new** washers (3)
3. Tighten bleeder screw assemblies to 23.0-26.0 Nm (17.0-19.2 ft-lbs).
4. Install wire ties removed during disassembly.
5. Install screw (7) and tighten to 6-10 Nm (53.0-88.4 **in-lbs**).
6. Tighten banjo bolt to ABS module to 17.0-20.0 Nm (13.0-14.7 ft-lbs).
7. Obtain BASIC VACUUM BRAKE BLEEDER (Part No. Snap-On BB200A) or equivalent tool. Add brake fluid and bleed front brake system.
8. Connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and confirm that front brake system is both properly connected and bled.




1. **ABS module**
2. **ABS module cover**
3. **Copper washer**
4. **Bolt**
5. **ABS module to front calipers brake line**
6. **Clip**
7. **Screw**
8. **Bleeder screw assembly**

**Figure C-11. ABS Module to Front Brake Calipers Brake Like**

## REAR MASTER CYLINDER TO ABS MODULE

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48650 | DIGITAL TECHNICIAN II |

### Removal

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove Maxi-Fuse. See 8.4 MAXI-FUSE.

*NOTE*

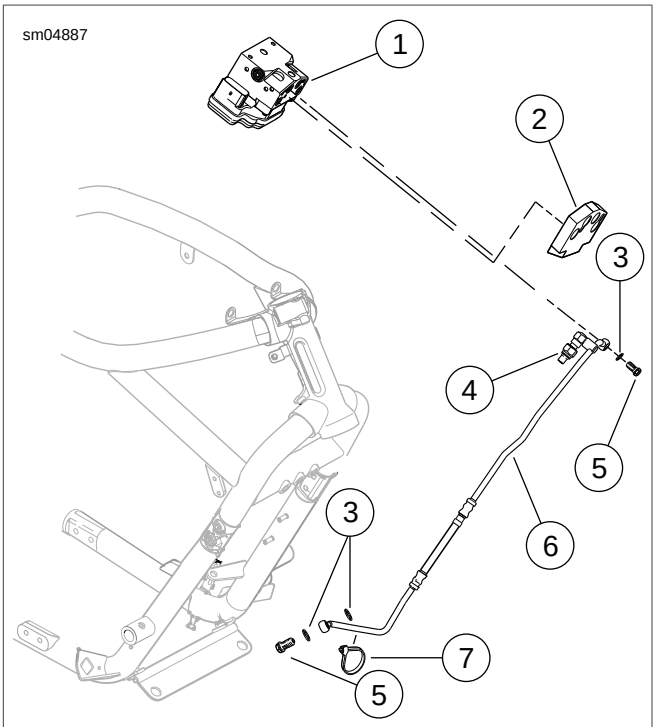
*Cover any exposed painted areas to protect them from contact with brake fluid during the removal and installation procedures.*

2. Drain rear brake system.

*NOTE*

*Note location and routing of brake line prior to removal.*

3. See Figure C-12. Remove banjo bolt to remove brake line from MR port of ABS module. Discard washers.
4. Disconnect wiring lead from stoplight switch (4).
5. Remove cover and empty master cylinder reservoir.
6. Remove banjo bolt to release brake line from master cylinder. Discard washers.
7. Remove any cable straps (7) retaining brake line and remove brake line from motorcycle.




1. **ABS module**
2. **ABS module cover**
3. **Copper washer**
4. **Stoplight switch**
5. **Bolt**
6. **ABS module to rear master cylinder brake line**
7. **Cable strap**

**Figure C-12. ABS Module To Rear Master Cylinder**

### Installation

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. See Figure C-12 Install **new** brake line exactly as original brake line was routed.
2. Start banjo bolt (5) with **new** washers (3) to secure brake line to MR port of ABS module.

*NOTE*

*If installing a **new** stoplight switch, apply Loctite Pipe Sealant with Teflon 565 to threads and start switch threading switch into rear brake line. Tighten switch to 16.3-20.3 Nm (12-15 ft-lbs).*

3. Start banjo bolt (5) with **new** washers (3) to secure brake line to rear master cylinder.
4. Tighten banjo bolt to master cylinder to 23-29 Nm (17-21.4 ft-lbs).
5. TIghten banjo bolt to ABS module to 17-20 Nm (12.5-14.7 ft-lbs).
6. Install wiring harness connector on brake light switch.
7. Install and cable straps removed during the removal procedure.

8. Fill and bleed brake system. See 1.12 BLEEDING BRAKES.

9. If more than one brake line was removed:
   a. Confirm that brake system is properly connected. To accomplish this, install master cylinder reservoir cover, connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and perform "ABS Service" procedure in the "Toolbox" menu.
   b. Repeat bleeding procedure if brakes still feel spongy.

## ABS MODULE TO REAR BRAKE CALIPER

| PART NUMBER | TOOL NAME |
|---|---|
| HD-48650 | DIGITAL TECHNICIAN II |

### Removal

**WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Remove Maxi-Fuse. See 1.6 RADIATOR SIDE COVERS.
2. Remove right side radiator cover. See 1.6 RADIATOR SIDE COVERS.

*NOTE*

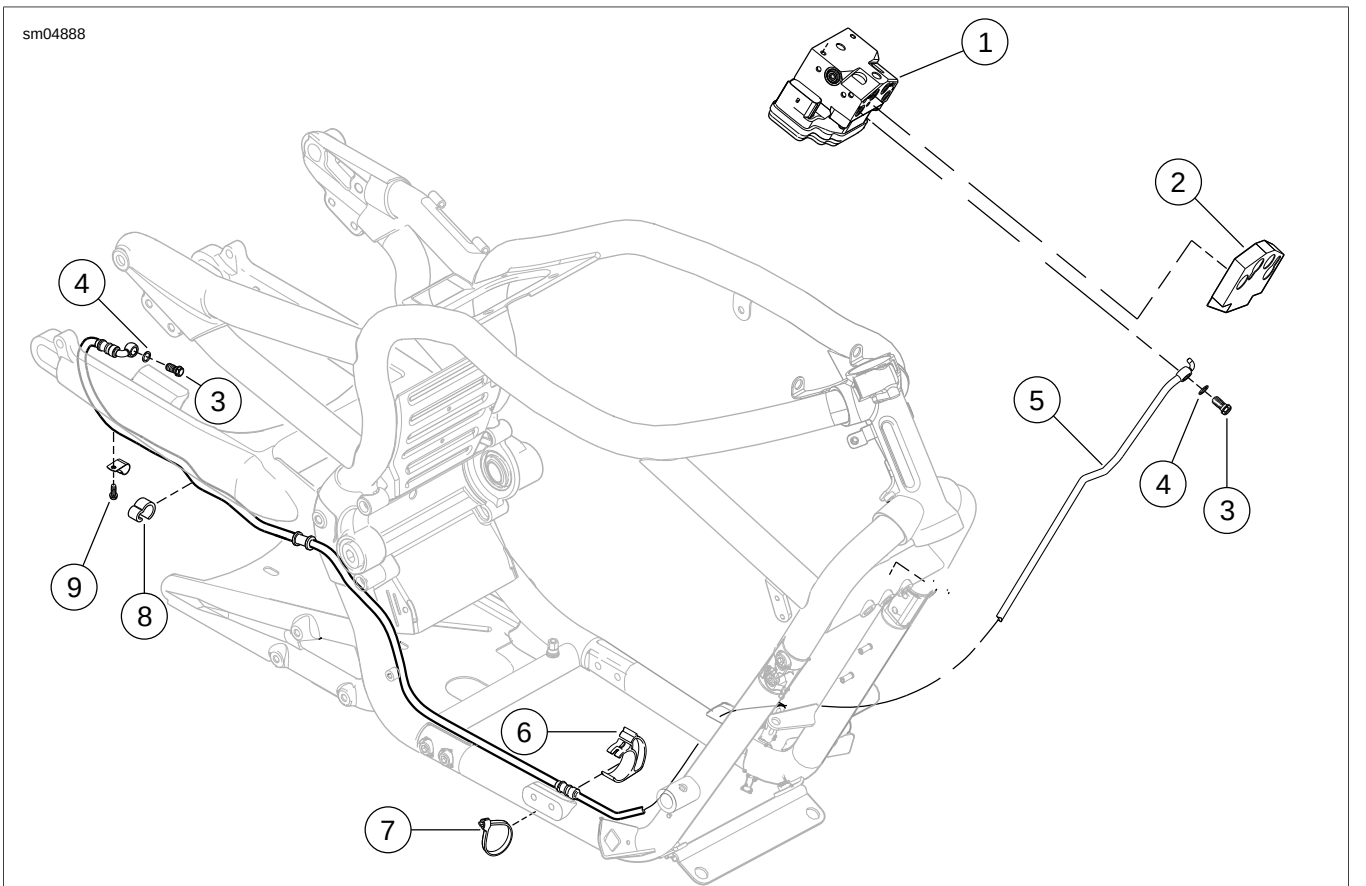
*Cover any exposed painted areas to protect them from contact with brake fluid during the removal and installation procedures.*

3. Drain rear brake system.
4. Remove cover and empty master cylinder reservoir.
5. Remove exhaust system from motorcycle. See 4.14 EXHAUST SYSTEM: VRSCAW. See 4.15 EXHAUST SYSTEM: VRSCD See 4.16 EXHAUST SYSTEM: VRSCDX.

*NOTE*

*Note location and routing of brake line prior to removal.*

6. See Figure C-13. Remove banjo bolt to remove brake line from R port of ABS module. Discard copper washers.
7. Remove banjo bolt to release brake line from rear caliper. Discard copper washers.
8. Remove any cable straps (7) and clips (8) retaining brake line.
9. Remove clamp and fastener (9).
10. Remove brake line (5) from motorcycle.




1. **ABS module**
2. **ABS module cover**
3. **Bolt**
4. **Copper washer**
5. **ABS module to rear brake caliper brake line**
6. **Retainer**
7. **Cable strap**
8. **Clip**
9. **Clamp and fastener**

**Figure C-13. ABS Module To Rear Brake Caliper Brake Line**

## Installation

**⚠WARNING**

**To prevent accidental vehicle start-up, which could cause death or serious injury, remove main fuse before proceeding. (00251b)**

1. Install **new** brake line exactly as original brake line was routed.
2. See Figure C-13. Start banjo bolt (3) with **new** copper washers (4) to secure brake line to R port of ABS module.
3. Start banjo bolt (3) with **new** copper washers (4) to secure brake line to rear brake caliper.
4. Install any cable straps (7) and clips (8) removed during disassembly.
5. Install clamp and fastener (9).
6. Tighten banjo bolt to caliper to 23-29 Nm (17-21.4 ft-lb).
7. TIghten banjo bolt to ABS module to 17-20 Nm (12.5-14.7 ft-lbs).
8. Install Maxi-Fuse. See 1.6 RADIATOR SIDE COVERS.
9. Fill and bleed brake system. See 1.12 BLEEDING BRAKES.
10. If more than one brake line was removed:
    a. Confirm that brake system is properly connected. To accomplish this, install master cylinder reservoir cover, connect motorcycle to DIGITAL TECHNICIAN II (Part No. HD-48650) and perform "ABS Setup" procedure in the "Toolbox" menu.
    b. Repeat bleeding procedure if brakes still feel spongy.
11. Install right side radiator cover. See 1.6 RADIATOR SIDE COVERS.
12. Install exhaust system from motorcycle. See 4.14 EXHAUST SYSTEM: VRSCAW. See 4.15 EXHAUST SYSTEM: VRSCD. See 4.16 EXHAUST SYSTEM: VRSCDX.

# NOTES

**SUBJECT** **PAGE NO.**
D.1 VALVE TAPPET SHIMS....D-1
D.2 VALVE LASH CALCULATION WORKSHEET 1....D-2
D.3 VALVE LASH CALCULATION WORKSHEET 2....D-3

# NOTES

## TABLES

**Table D-1. Case 1 Valve Tappet Shims**

| Part No. | Shim Thickness |
|---|---|
| H-D 18696-01K | 1.825 mm |
| H-D 18697-01K | 1.850 mm |
| H-D 18697-01K | 1.850 mm |
| H-D 18698-01K | 1.875 mm |
| H-D 18699-01K | 1.900 mm |
| H-D 18700-01K | 1.925 mm |
| H-D 18701-01K | 1.950 mm |
| H-D 18702-01K | 1.975 mm |
| H-D 18666-01K | 2.000 mm |
| H-D 18624-01K | 2.025 mm |
| H-D 18667-01K | 2.050 mm |
| H-D 18625-01K | 2.075 mm |
| H-D 18668-01K | 2.100 mm |
| H-D 18626-01K | 2.125 mm |
| H-D 18669-01K | 2.150 mm |
| H-D 18627-01K | 2.175 mm |
| H-D 18670-01K | 2.200 mm |
| H-D 18628-01K | 2.225 mm |
| H-D 18628-01K | 2.250 mm |
| H-D 18629-01K | 2.275 mm |
| H-D 18672-01K | 2.300 mm |
| H-D 18630-01K | 2.325 mm |
| H-D 18673-01K | 2.350 mm |
| H-D 18631-01K | 2.375 mm |
| H-D 18674-01K | 2.400 mm |

**Table D-2. Case 2 Valve Tappet Shims**

| Part No. | Shim Thickness |
|---|---|
| H-D 18632-01K | 1.825 mm |
| H-D 18675-01K | 1.850 mm |
| H-D 18638-01K | 1.875 mm |
| H-D 18676-01K | 1.900 mm |
| H-D 18639-01K | 1.925 mm |
| H-D 18677-01K | 1.950 mm |
| H-D 18655-01K | 1.975 mm |
| H-D 18678-01K | 2.000 mm |
| H-D 18656-01K | 2.025 mm |
| H-D 18679-01K | 2.050 mm |
| H-D 18657-01K | 2.075 mm |
| H-D 18680-01K | 2.100 mm |
| H-D 18658-01K | 2.125 mm |
| H-D 18681-01K | 2.150 mm |
| H-D 18659-01K | 2.150 mm |
| H-D 18682-01K | 2.175 mm |
| H-D 18692-01K | 2.200 mm |
| H-D 18683-01K | 2.225 mm |
| H-D 18693-01K | 2.250 mm |
| H-D 18684-01K | 2.275 mm |
| H-D 18694-01K | 2.300 mm |
| H-D 18685-01K | 2.325 mm |
| H-D 18695-01K | 2.350 mm |
| H-D 18686-01K | 2.375 mm |

## WORKSHEET 1

**Table D-3. Valve Lash: Front Cylinder (Measurements)**

| Valve Number | Valve Type | Initial Lash Measurement (1) | Installed Shim Measurement (2) | Valve Lash Upper Limit, mm (in.) (3) | Valve Lash Lower Limit, mm (in.) (4) |
|---|---|---|---|---|---|
| 1 | Exhaust | | | 0.345 (0.0135) | 0.295 (0.0117) |
| 2 | Exhaust | | | 0.345 (0.0135) | 0.295 (0.0117) |
| 3 | Intake | | | 0.245 (0.0096) | 0.195 (0.0078) |
| 4 | Intake | | | 0.245 (0.0096) | 0.195 (0.0078) |

**Table D-4. Valve Lash: Front Cylinder (Calculations)**

| Valve Number | Valve Type | NEW SHIM LOWER LIMIT Calculate Columns (1)+(2)-(3) (L) | NEW SHIM UPPER LIMIT Calculate Columns (1)+(2)-(4) (U) | DESIRED SHIM SIZE Calculate Columns ((L)+(U))/(2) = (S) (S) | Shim Size Chosen (closest to column S) | Final Lash Reading |
|---|---|---|---|---|---|---|
| 1 | Exhaust | | | | | |
| 2 | Exhaust | | | | | |
| 3 | Intake | | | | | |
| 4 | Intake | | | | | |

**Table D-5. Valve Lash: Rear Cylinder (Measurements)**

| Valve Number | Valve Type | Initial Lash Measurement (1) | Installed Shim Measurement (2) | Valve Lash Upper Limit, mm (in.) (3) | Valve Lash Lower Limit, mm (in.) (4) |
|---|---|---|---|---|---|
| 5 | Intake | | | 0.245 (0.0096) | 0.195 (0.0078) |
| 6 | Intake | | | 0.245 (0.0096) | 0.195 (0.0078) |
| 7 | Exhaust | | | 0.345 (0.0135) | 0.295 (0.0117) |
| 8 | Exhaust | | | 0.345 (0.0135) | 0.295 (0.0117) |

**Table D-6. Valve Lash: Rear Cylinder (Calculations)**

| Valve Number | Valve Type | NEW SHIM LOWER LIMIT Calculate Columns (1)+(2)-(3) (L) | NEW SHIM UPPER LIMIT Calculate Columns (1)+(2)-(4) (U) | DESIRED SHIM SIZE Calculate Columns ((L)+(U))/(2) = (S) (S) | Shim Size Chosen (closest to column S) | Final Lash Reading |
|---|---|---|---|---|---|---|
| 5 | Intake | | | | | |
| 6 | Intake | | | | | |
| 7 | Exhaust | | | | | |
| 8 | Exhaust | | | | | |

## WORKSHEET 2

**Table D-7. Valve Lash: Front Cylinder (Measurements)**

| Valve Number | Valve Type | Initial Lash Measurement (1) | Installed Shim Measurement (2) | Valve Lash Upper Limit, mm (in.) (3) | Valve Lash Lower Limit, mm (in.) (4) |
|---|---|---|---|---|---|
| 1 | Exhaust | | | 0.345 (0.0135) | 0.295 (0.0117) |
| 2 | Exhaust | | | 0.345 (0.0135) | 0.295 (0.0117) |
| 3 | Intake | | | 0.245 (0.0096) | 0.195 (0.0078) |
| 4 | Intake | | | 0.245 (0.0096) | 0.195 (0.0078) |

**Table D-8. Valve Lash: Front Cylinder (Calculations)**

| Valve Number | Valve Type | NEW SHIM LOWER LIMIT Calculate Columns (1)+(2)-(3) (L) | NEW SHIM UPPER LIMIT Calculate Columns (1)+(2)-(4) (U) | DESIRED SHIM SIZE Calculate Columns ((L)+(U))/(2) = (S) (S) | Shim Size Chosen (closest to column S) | Final Lash Reading |
|---|---|---|---|---|---|---|
| 1 | Exhaust | | | | | |
| 2 | Exhaust | | | | | |
| 3 | Intake | | | | | |
| 4 | Intake | | | | | |

**Table D-9. Valve Lash: Rear Cylinder (Measurements)**

| Valve Number | Valve Type | Initial Lash Measurement (1) | Installed Shim Measurement (2) | Valve Lash Upper Limit, mm (in.) (3) | Valve Lash Lower Limit, mm (in.) (4) |
|---|---|---|---|---|---|
| 5 | Intake | | | 0.245 (0.0096) | 0.195 (0.0078) |
| 6 | Intake | | | 0.245 (0.0096) | 0.195 (0.0078) |
| 7 | Exhaust | | | 0.345 (0.0135) | 0.295 (0.0117) |
| 8 | Exhaust | | | 0.345 (0.0135) | 0.295 (0.0117) |

**Table D-10. Valve Lash: Rear Cylinder (Calculations)**

| Valve Number | Valve Type | NEW SHIM LOWER LIMIT Calculate Columns (1)+(2)-(3) (L) | NEW SHIM UPPER LIMIT Calculate Columns (1)+(2)-(4) (U) | DESIRED SHIM SIZE Calculate Columns ((L)+(U))/(2) = (S) (S) | Shim Size Chosen (closest to column S) | Final Lash Reading |
|---|---|---|---|---|---|---|
| 5 | Intake | | | | | |
| 6 | Intake | | | | | |
| 7 | Exhaust | | | | | |
| 8 | Exhaust | | | | | |

# NOTES

**SUBJECT** **PAGE NO.**

E.1 LENGTH CONVERSION.....E-1
E.2 FLUID CONVERSION.....E-2
E.3 TORQUE CONVERSION.....E-3

# NOTES

## CONVERSION TABLE

**Table E-1. Metric Conversions**

| MILLIMETERS to INCHES (MM x 0.03937 = IN.) | | | | | | | | INCHES to MILLIMETERS (IN. x 25.40 = MM) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MM | IN. | MM | IN. | MM | IN. | MM | IN.. | IN. | MM | IN. | MM | IN. | MM | IN. | MM |
| .1 | .0039 | 25 | .9842 | 58 | 2.283 | 91 | 3.582 | .001 | .025 | .6 | 15.240 | 1-15/16 | 49.21 | 3-5/16 | 84.14 |
| .2 | .0078 | 26 | 1.024 | 59 | 2.323 | 92 | 3.622 | .002 | .051 | 5/8 | 15.875 | 2 | 50.80 | 3-3/8 | 85.72 |
| .3 | .0118 | 27 | 1.063 | 60 | 2.362 | 93 | 3.661 | .003 | .076 | 11/16 | 17.462 | 2-1/16 | 52.39 | 3.4 | 86.36 |
| .4 | .0157 | 28 | 1.102 | 61 | 2.401 | 94 | 3.701 | .004 | .102 | .7 | 17.780 | 2.1 | 53.34 | 3-7/16 | 87.31 |
| .5 | .0197 | 29 | 1.142 | 62 | 2.441 | 95 | 3.740 | .005 | .127 | 3/4 | 19.050 | 2-1/8 | 53.97 | 3-1/2 | 88.90 |
| .6 | .0236 | 30 | 1.181 | 63 | 2.480 | 96 | 3.779 | .006 | .152 | .8 | 20.320 | 2-3/16 | 55.56 | 3-9/16 | 90.49 |
| .7 | .0275 | 31 | 1.220 | 64 | 2.519 | 97 | 3.819 | .007 | .178 | 13/16 | 20.638 | 2.2 | 55.88 | 3.6 | 91.44 |
| .8 | .0315 | 32 | 1.260 | 65 | 2.559 | 98 | 3.858 | .008 | .203 | 7/8 | 22.225 | 2-1/4 | 57.15 | 3-5/8 | 92.07 |
| .9 | .0354 | 33 | 1.299 | 66 | 2.598 | 99 | 3.897 | .009 | .229 | .9 | 22.860 | 2.3 | 58.42 | 3-11/16 | 93.66 |
| 1 | .0394 | 34 | 1.338 | 67 | 2.638 | 100 | 3.937 | .010 | .254 | 15/16 | 23.812 | 2-5/16 | 58.74 | 3.7 | 93.98 |
| 2 | .0787 | 35 | 1.378 | 68 | 2.677 | 101 | 3.976 | 1/64 | .397 | 1 | 25.40 | 2-3/8 | 60.32 | 3-3/4 | 95.25 |
| 3 | .1181 | 36 | 1.417 | 69 | 2.716 | 102 | 4.016 | .020 | .508 | 1-1/16 | 26.99 | 2.4 | 60.96 | 3.8 | 96.52 |
| 4 | .1575 | 37 | 1.456 | 70 | 2.756 | 103 | 4.055 | .030 | .762 | 1.1 | 27.94 | 2-7/16 | 61.91 | 3-13/16 | 96.84 |
| 5 | .1968 | 38 | 1.496 | 71 | 2.795 | 104 | 4.094 | 1/32 | .794 | 1-1/8 | 28.57 | 2-1/2 | 63.50 | 3-7/8 | 98.42 |
| 6 | .2362 | 39 | 1.535 | 72 | 2.834 | 105 | 4.134 | .040 | 1.016 | 1-3/16 | 30.16 | 2-9/16 | 65.09 | 3.9 | 99.06 |
| 7 | .2756 | 40 | 1.575 | 73 | 2.874 | 106 | 4.173 | .050 | 1.270 | 1.2 | 30.48 | 2.6 | 66.04 | 3-15/16 | 100.01 |
| 8 | .3149 | 41 | 1.614 | 74 | 2.913 | 107 | 4.212 | .060 | 1.524 | 1-1/4 | 31.75 | 2-5/8 | 66.67 | 4 | 101.6 |
| 9 | .3543 | 42 | 1.653 | 75 | 2.953 | 108 | 4.252 | 1/16 | 1.588 | 1.3 | 33.02 | 2-11/16 | 68.26 | 4-1/16 | 102.19 |
| 10 | .3937 | 43 | 1.693 | 76 | 2.992 | 109 | 4.291 | .070 | 1.778 | 1-5/16 | 33.34 | 2.7 | 68.58 | 4.1 | 104.14 |
| 11 | .4331 | 44 | 1.732 | 77 | 3.031 | 110 | 4.331 | .080 | 2.032 | 1-3/8 | 34.92 | 2-3/4 | 69.85 | 4-1/8 | 104.77 |
| 12 | .4724 | 45 | 1.772 | 78 | 3.071 | 111 | 4.370 | .090 | 2.286 | 1.4 | 35.56 | 2.8 | 71.12 | 4-3/16 | 106.36 |
| 13 | .5118 | 46 | 1.811 | 79 | 3.110 | 112 | 4.409 | .1 | 2.540 | 1-7/16 | 36.51 | 2-13/16 | 71.44 | 4.2 | 106.68 |
| 14 | .5512 | 47 | 1.850 | 80 | 3.149 | 113 | 4.449 | 1/8 | 3.175 | 1-1/2 | 38.10 | 2-7/8 | 73.02 | 4-1/4 | 107.95 |
| 15 | .5905 | 48 | 1.890 | 81 | 3.189 | 114 | 4.488 | 3/16 | 4.762 | 1-9/16 | 39.69 | 2.9 | 73.66 | 4.3 | 109.22 |
| 16 | .6299 | 49 | 1.929 | 82 | 3.228 | 115 | 4.527 | .2 | 5.080 | 1.6 | 40.64 | 2-15/16 | 74.61 | 4-5/16 | 109.54 |
| 17 | .6693 | 50 | 1.968 | 83 | 3.268 | 116 | 4.567 | 1/4 | 6.350 | 1-5/8 | 41.27 | 3 | 76.20 | 4-3/8 | 111.12 |
| 18 | .7086 | 51 | 2.008 | 84 | 3.307 | 117 | 4.606 | .3 | 7.620 | 1-11/16 | 42.86 | 3-1/16 | 77.79 | 4.4 | 111.76 |
| 19 | .7480 | 52 | 2.047 | 85 | 3.346 | 118 | 4.645 | 5/16 | 7.938 | 1.7 | 43.18 | 3.1 | 78.74 | 4-7/16 | 112.71 |
| 20 | .7874 | 53 | 2.086 | 86 | 3.386 | 119 | 4.685 | 3/8 | 9.525 | 1-3/4 | 44.45 | 3-1/8 | 79.37 | 4-1/2 | 114.30 |
| 21 | .8268 | 54 | 2.126 | 87 | 3.425 | 120 | 4.724 | .4 | 10.160 | 1.8 | 45.72 | 3-3/16 | 80.96 | 4-9/16 | 115.89 |
| 22 | .8661 | 55 | 2.165 | 88 | 3.464 | 121 | 4.764 | 7/16 | 11.112 | 1-13/16 | 46.04 | 3.2 | 81.28 | 4.6 | 116.84 |
| 23 | .9055 | 56 | 2.205 | 89 | 3.504 | 122 | 4.803 | 1/2 | 12.700 | 1-7/8 | 47.62 | 3-1/4 | 82.55 | 4-5/8 | 117.47 |
| 24 | .9449 | 57 | 2.244 | 90 | 3.543 | 123 | 4.842 | 9/16 | 14.288 | 1.9 | 48.26 | 3.3 | 83.82 | 4-11/16 | 119.06 |

# FLUID CONVERSION E.2

## UNITED STATES SYSTEM

Unless otherwise specified, all fluid volume measurements in this Service Manual are expressed in United States (U.S.) units-of-measure. See below:

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

## METRIC SYSTEM

Fluid volume measurements in this Service Manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). Should you need to convert from U.S. units-of-measure to metric units-of-measure (or vice versa), refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

## BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this Service Manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. Should you need to convert from U.S. units to British Imperial units (or vice versa), refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)
- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)

# TORQUE CONVERSION E.3

## UNITED STATES SYSTEM

The U.S. units of torque, foot pounds and inch pounds, are used in this service manual. To convert units, use the following equations:

- foot pounds (ft-lbs) X 12.00000 = inch pounds (**in-lbs**).
- inch pounds (**in-lbs**) X 0.08333 = foot pounds (ft-lbs).

## METRIC SYSTEM

All metric torque specifications are written in Newton-meters (Nm). To convert metric to United States units and United States to metric, use the following equations:

- Newton meters (Nm) X 0.737563 = foot pounds (ft-lbs).
- Newton meters (Nm) X 8.85085 = inch pounds (**in-lbs).**
- foot pounds (ft-lbs) X 1.35582 = Newton meters (Nm).
- inch pounds (**in-lbs**) X 0.112985 = Newton meters (Nm).

# NOTES

**SUBJECT** **PAGE NO.**
F.1 GLOSSARY.....F-1

# NOTES

## ACRONYMS AND ABBREVIATIONS

**Table F-1. Acronyms and Abbreviations**

| ACRONYM OR ABBREVIATION | DESCRIPTION |
|---|---|
| A | Amperes |
| AC | Alternating Current |
| ACC | Accessory |
| ACR | Automatic Compression Release |
| AGM | Absorbed Glass Mat (battery) |
| AMP | Ampere |
| AWG | American Wire Gauge |
| B+ | Battery Voltage |
| BAS | Bank Angle Sensor |
| BTDC | Before Top Dead Center |
| C | Celsius (Centigrade) |
| CA | California |
| CAL | Calibration |
| CC | Cubic Centimeters |
| CCA | Cold Cranking Amps |
| CKP | Crankshaft Position |
| cm | Centimeter |
| DC | Direct Current |
| DLC | Data Link Connector |
| DOM | Domestic |
| DTC | Diagnostic Trouble Code |
| DVOM | Digital Volt Ohm Meter |
| ECM | Electronic Control Module |
| ECT | Engine Coolant Temperature |
| EEPROM | Electrically Erasable Programmable Read Only Memory |
| EFI | Electronic Fuel Injection |
| ET | Engine Temperature |
| EVAP | Evaporative Emissions Control System |
| F | Fahrenheit |
| ft-lbs | Foot-Pounds |
| fl oz. | Fluid Ounce |
| g | Gram |
| GAL | Gallon |
| GAWR | Gross Axle Weight Rating |
| GND | Ground (electrical) |
| GVWR | Gross Vehicle Weight Rating |
| HDI | Harley-Davidson International |
| H-DSSS | Harley-Davidson Smart Security System |
| HFSM | Hands Free Security Module |
| Hg | Mercury |
| IAC | Idle Air Control |

**Table F-1. Acronyms and Abbreviations**

| ACRONYM OR ABBREVIATION | DESCRIPTION |
|---|---|
| IAT | Intake Air Temperature |
| ID | Inside Diameter |
| IGN | Ignition Light/Key Switch |
| IM | Instrument Module |
| In. | Inch |
| INJ PW | Injector Pulse Width |
| in-lbs | Inch-Pounds |
| Kg | Kilogram |
| Km | Kilometer |
| kPa | Kilopascal |
| km/hr | Kilometers Per Hour |
| L | Liter |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| mA | Milliampere |
| MAP | Manifold Absolute Pressure |
| ml | milliliter |
| mm | millimeter |
| MPH | Miles Per Hour |
| ms | millisecond |
| Nm | Newton-Meter |
| N/A | Not Applicable |
| no. | Number |
| O2 | Oxygen |
| OD | Outside Diameter |
| OEM | Original Equipment Manufacturer |
| oz | Ounce |
| P&A | Parts and Accessories |
| PN | Part Number |
| PSI | Pounds per Square Inch |
| RES | Reserve |
| RPM | Revolutions Per Minute |
| SCFH | Cubic Feet per Hour at Standard Conditions |
| TCA | Throttle Control Actuator |
| TDC | Top Dead Center |
| TGS | Twist Grip Sensor |
| TP | Throttle Position |
| TMAP | Intake Air Temperature/Manifold Absolute Pressure |
| TSM | Turn Signal Module |
| TSSM | Turn Signal/Security Module |
| V | Volt |
| VAC | Volts of Alternating Current |
| VDC | Volts of Direct Current |

**Table F-1. Acronyms and Abbreviations**

| ACRONYM OR ABBREVIATION | DESCRIPTION |
|---|---|
| VIN | Vehicle Identification Number |
| VSS | Vehicle Speed Sensor |

# NOTES

# Tools Used in This Manual

| PART NUMBER | TOOL NAME | NOTES |
|---|---|---|
| 1MFLE140 | SNAP-ON | 3.9 CYLINDER HEAD, Removal |
| 94700-52C | SPANNER WRENCH | 1.20 SUSPENSION ADJUSTMENTS, Rear Shock Absorbers: VRSC Models |
| 98716-87A | STORAGE COVER | 1.29 STORAGE, Placing in Storage |
| 99863-01A | GLOBAL BATTERY CHARGER | 1.9 BATTERY MAINTENANCE, Storage |
| B-45305 | FORK SEAL DRIVER | 2.33 FRONT FORK, Assembly |
| DC2001 | SNAP-ON METRIC BOLT GRIP PULLER SET | 1.19 DRIVE SPROCKET FLANGE, Replacement |
| GA500A | SNAP-ON TERMINAL PICK | A.3 AUTOFUSE ELECTRICAL CONNECTOR, Autofuse Connector Repair |
| HD-23688 FAHRENHEIT | BATTERY TESTER | 6.3 ENGINE COOLANT, Replacing Coolant |
| HD-25070 | ROBINAIR HEAT GUN | 6.6 COOLANT PIPES AND HOSES, Assembly |
| HD-25070 | ROBINAIR HEAT GUN | 8.23 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures |
| HD-25070 | ROBINAIR HEAT GUN | A.19 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair |
| HD-26568 CELSIUS | BATTERY TESTER | 6.3 ENGINE COOLANT, Replacing Coolant |
| HD-29545-6 | COOLANT FLUORESCENT LEAK DETECTION DYE | 6.2 COOLANT FLOW, Leak Detection Dye Test |
| HD-33223-1 | CYLINDER COMPRESSION GAUGE | 3.6 TROUBLESHOOTING, Compression Test |
| HD-33416 | UNIVERSAL DRIVER HANDLE | 2.34 STEERING HEAD, Cleaning and Inspection |
| HD-34736-B | VALVE SPRING COMPRESSOR | 3.9 CYLINDER HEAD, Disassembly |
| HD-34736-B | VALVE SPRING COMPRESSOR | 3.9 CYLINDER HEAD, Head Assembly |
| HD-34751 | VALVE GUIDE CLEANING BRUSH | 3.9 CYLINDER HEAD, Disassembly |
| HD-34751 | CLEANING BRUSH | 3.9 CYLINDER HEAD, Valve Seat Refacing |
| HD-34902-B | BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER | 7.4 COUNTERBALANCER BEARING REPLACEMENT, Removal |
| HD-34902-B | BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER | 7.7 INPUT SHAFT, Disassembly - 2nd Gear End |
| HD-35381 | BELT TENSION GAUGE | 1.16 REAR BELT DEFLECTION , Inspection |
| HD-35457 | BLACK LIGHT LEAK DETECTOR | 6.2 COOLANT FLOW, Leak Detection Dye Test |
| HD-35667A | CYLINDER LEAKDOWN TESTER | 3.6 TROUBLESHOOTING, Cylinder Leakage Test |
| HD-35758-50 | NEWAY VALVE SEAT CUTTER SET | 3.9 CYLINDER HEAD, Valve Seat Refacing |
| HD-35758-51 | 6 MM PILOT | 3.9 CYLINDER HEAD, Disassembly |
| HD-38125-6 | PACKARD TERMINAL CRIMP TOOL | A.16 PACKARD METRI-PACK TERMINALS, Metri-Pack Terminal Crimps |
| HD-38125-7 | PACKARD TERMINAL CRIMPER | A.1 AMP 1-PLACE CONNECTORS, AMP 1-Place Connector Repair |
| HD-38125-7 | PACKARD TERMINAL CRIMPER | A.8 DEUTSCH MINI-TERMINAL CRIMPS, Deutsch Mini Terminal Crimps |
| HD-38125-7 | PACKARD TERMINAL CRIMPER | A.16 PACKARD METRI-PACK TERMINALS, Metri-Pack Terminal Crimps |
| HD-38125-8 | PACKARD CRIMPING TOOL | A.16 PACKARD METRI-PACK TERMINALS, Metri-Pack Terminal Crimps |
| HD-38125-8 | PACKARD CRIMPING TOOL | A.19 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair |
| HD-39301-A | STEERING HEAD BEARING RACE REMOVER | 2.34 STEERING HEAD, Cleaning and Inspection |

# Tools Used in This Manual

| PART NUMBER | TOOL NAME | NOTES |
|---|---|---|
| HD-39302 | STEERING HEAD BEARING RACE INSTALLER | 2.34 STEERING HEAD, Assembly |
| HD-39621-27 | SOCKET TERMINAL TOOL | A.1 AMP 1-PLACE CONNECTORS, AMP 1-Place Connector Repair |
| HD-39621-28 | PIN TERMINAL REMOVER | A.1 AMP 1-PLACE CONNECTORS, AMP 1-Place Connector Repair |
| HD-39782 | CYLINDER HEAD SUPPORT STAND | 3.9 CYLINDER HEAD, Disassembly |
| HD-39782-13 | CYLINDER SUPPORT ADAPTER | 3.9 CYLINDER HEAD, Disassembly |
| HD-39782-14 | CYLINDER SUPPORT ADAPTER | 3.9 CYLINDER HEAD, Disassembly |
| HD-39786 | CYLINDER HEAD HOLDING FIXTURE | 3.9 CYLINDER HEAD, Removal |
| HD-39786 | CYLINDER HEAD HOLDING FIXTURE | 3.9 CYLINDER HEAD, Valve Seat Refacing |
| HD-39965-A | DEUTSCH TERMINAL CRIMP TOOL | A.9 DEUTSCH STANDARD TERMINALS, Deutsch Standard Terminal Crimps |
| HD-39969 | ULTRA TORCH UT-100 | 8.23 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures |
| HD-39969 | ULTRA TORCH UT-100 | A.19 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair |
| HD-41137 | HOSE CLAMP PLIERS | 2.18 REAR BRAKE MASTER CYLINDER AND RESERVOIR: FORWARD CONTROLS, Disassembly |
| HD-41177 | FORK TUBE HOLDER | 2.33 FRONT FORK, Disassembly |
| HD-41177 | FORK TUBE HOLDER | 2.33 FRONT FORK, Assembly |
| HD-41182 | FUEL PRESSURE GAUGE | 4.13 FUEL PRESSURE TEST, Testing |
| HD-41183 | HEAT SHIELD ATTACHMENT | 8.23 HANDLEBAR SWITCH ASSEMBLIES, Repair Procedures |
| HD-41183 | HEAT SHIELD ATTACHMENT | A.19 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair |
| HD-41417 | PROPANE ENRICHMENT KIT | 4.18 INTAKE LEAK TEST, Leak Tester |
| HD-41475 | DEUTSCH CONNECTOR SERVICE KIT | A.7 DEUSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair |
| HD-41475-100 | FLAT BLADE L-HOOK | A.7 DEUSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair |
| HD-41609 | AMP MULTILOCK CRIMPER | A.2 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair |
| HD-42310 | ENGINE TRANSMISSION STAND | 3.7 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand |
| HD-42310-100 | CRADLE LOCKING NUT AND SPACER | 3.7 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand |
| HD-42310-100 | CRADLE LOCKING NUT AND SPACER RING | 3.7 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand |
| HD-42310-40 | ENGINE CRADLE | 3.7 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand |
| HD-42879 | ELECTRICAL CRIMPER TOOL | A.10 DEUTSCH SOLID BARREL TERMINALS, Deutsch Solid Barrel Terminal Crimps |
| HD-43517 | ENGINE ASSEMBLY SUPPORT FIXTURE | 2.7 ENGINE REPLACEMENT, Removal |
| HD-43526 | PRIMARY CHAIN TENSIONER RETAINER | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Removal |

# Tools Used in This Manual

| PART NUMBER | TOOL NAME | NOTES |
|---|---|---|
| HD-43646-A | ROLLING ENGINE STAND | 3.7 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand |
| HD-43646-A | ROLLING ENGINE STAND | 3.7 STRIPPING MOTORCYCLE FOR SERVICE, Engine Cradle and Stand |
| HD-44060 | WHEEL BEARING INSTALLER/REMOVER | 2.28 SEALED WHEEL BEARINGS, Removal |
| HD-44060-4 | WHEEL BEARING REMOVAL/REPLACEMENT KIT | 2.38 SWINGARM, Disassembly and Assembly |
| HD-44358 | FLYWHEEL SUPPORT FIXTURE | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation |
| HD-45300 | OIL PRESSURE SWITCH SOCKET | 8.18 OIL PRESSURE SWITCH, Removal |
| HD-45301 | TRANSMISSION ASSEMBLY RETAINER TOOL | 3.10 UPPER AND LOWER CRANKCASE SEPARATION, Disassembly |
| HD-45301 | TRANSMISSION ASSEMBLY RETAINER TOOL | 7.3 TRANSMISSION, Assembly |
| HD-45301 | TRANSMISSION ASSEMBLY RETAINER | 7.3 TRANSMISSION, Assembly |
| HD-45304 | ALTERNATOR STATOR COVER REMOVER/INSTALLER | 3.10 UPPER AND LOWER CRANKCASE SEPARATION, Disassembly |
| HD-45304 | ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL | 8.13 ALTERNATOR, Removal |
| HD-45304 | ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL | 8.13 ALTERNATOR, Installation |
| HD-45306 | CRANKSHAFT LOCKING PIN | 1.25 VALVE LASH, Verify Cam Timing |
| HD-45306 | CRANKSHAFT LOCKING PIN | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Removal |
| HD-45306 | CRANKSHAFT LOCKING PIN | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation |
| HD-45306 | CRANKSHAFT LOCKING PIN | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| HD-45306 | CRANKSHAFT LOCKING PIN | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| HD-45306 | CRANKSHAFT LOCKING PIN | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation |
| HD-45306 | CRANKSHAFT LOCKING PIN | 7.3 TRANSMISSION, Assembly |
| HD-45307 | THERMOSTAT REMOVAL TOOL | 6.4 THERMOSTAT, Removal |
| HD-45308 | OIL PRESSURE GAUGE | 3.5 OIL PRESSURE, Checking Oil Pressure |
| HD-45309 | ADAPTER | 3.5 OIL PRESSURE, Checking Oil Pressure |
| HD-45310 | LOWER CRANKCASE ALIGNMENT DOWELS | 7.3 TRANSMISSION, Assembly |
| HD-45311 | COUNTERBALANCER ALIGNMENT PIN | 7.3 TRANSMISSION, Assembly |
| HD-45311 | COUNTERBALANCER ALIGNMENT PIN | 7.3 TRANSMISSION, Assembly |
| HD-45311 | COUNTERBALANCER ALIGNMENT PIN | 7.4 COUNTERBALANCER BEARING REPLACEMENT, Installation |
| HD-45312 | CAM CHAIN TENSIONER GUIDE PIN REMOVER/INSTALLER | 3.9 CYLINDER HEAD, Removal |
| HD-45313 | CYLINDER LINER REMOVER/INSTALLER | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation |

# Tools Used in This Manual

| PART NUMBER | TOOL NAME | NOTES |
|---|---|---|
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 1.25 VALVE LASH, Lash Measurement |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 1.25 VALVE LASH, Verify Cam Timing |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 1.25 VALVE LASH, Verify Cam Timing |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 1.26 SECONDARY CAM CHAIN, Adjustment |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 1.26 SECONDARY CAM CHAIN, Adjustment |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 3.6 TROUBLESHOOTING, Cylinder Leakage Test |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Removal |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 7.2 CLUTCH, Removal |
| HD-45314 | CRANKSHAFT ROTATING WRENCH | 8.13 ALTERNATOR, Removal |
| HD-45315 | ALTERNATOR ROTOR REMOVER | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Removal |
| HD-45315 | ALTERNATOR ROTOR REMOVER | 8.13 ALTERNATOR, Removal |
| HD-45316 | CRANKSHAFT ASSEMBLY RETAINER | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| HD-45316 | CRANKSHAFT ASSEMBLY RETAINER | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation |
| HD-45316 | CRANKSHAFT ASSEMBLY RETAINER | 7.3 TRANSMISSION, Assembly |
| HD-45317 | ENGINE ASSEMBLY SUPPORT FIXTURE | 2.6 REAR ENGINE MOUNTS, Removal |
| HD-45317 | ENGINE ASSEMBLY SUPPORT FIXTURE | 2.7 ENGINE REPLACEMENT, Installation |
| HD-45319 | VALVE GUIDE REAMER | 3.9 CYLINDER HEAD, Disassembly |
| HD-45320 | VALVE GUIDE REMOVER/INSTALLER | 3.9 CYLINDER HEAD, Disassembly |
| HD-45321 | VALVE GUIDE FLEX HONE | 3.9 CYLINDER HEAD, Disassembly |
| HD-45322 | VALVE GUIDE SEAL INSTALLER | 3.9 CYLINDER HEAD, Head Assembly |
| HD-45326 | PRIMARY CAM CHAIN TENSIONER RETAINER | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation |
| HD-45331-A | FINAL DRIVE SPROCKET FLANGE LOCKING TOOL | 1.19 DRIVE SPROCKET FLANGE, Replacement |
| HD-45331-A | FINAL DRIVE SPROCKET FLANGE LOCKING TOOL | 1.19 DRIVE SPROCKET FLANGE, Replacement |
| HD-45331-A | FINAL DRIVE SPROCKET FLANGE LOCKING TOOL | 7.6 OUTPUT SHAFT, Disassembly - 2nd Gear End |
| HD-45331-A | FINAL DRIVE SPROCKET FLANGE LOCKING TOOL | 7.6 OUTPUT SHAFT, Disassembly - 2nd Gear End |
| HD-45332 | FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER | 1.19 DRIVE SPROCKET FLANGE, Replacement |
| HD-45332 | FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER | 7.6 OUTPUT SHAFT, Disassembly - 2nd Gear End |
| HD-45333 | CYLINDER HEAD HOLDER | 3.9 CYLINDER HEAD, Removal |
| HD-45333 | CYLINDER HEAD HOLDER | 3.9 CYLINDER HEAD, Valve Seat Refacing |

# Tools Used in This Manual

| PART NUMBER | TOOL NAME | NOTES |
|---|---|---|
| HD-45334 | SECONDARY CAM CHAIN MEASUREMENT TOOL | 1.26 SECONDARY CAM CHAIN, Adjustment |
| HD-45334 | SECONDARY CAM CHAIN MEASUREMENT TOOL | 1.26 SECONDARY CAM CHAIN, Adjustment |
| HD-45334 | SECONDARY CAM CHAIN MEASUREMENT TOOL | 3.6 TROUBLESHOOTING, Diagnosing Valve Train Noise |
| HD-45335 | COOLANT SYSTEM PRESSURE TESTER | 6.2 COOLANT FLOW, Pressure Cap Test |
| HD-45335 | COOLANT SYSTEM PRESSURE TESTER | 6.2 COOLANT FLOW, Tests for Blown Gasket |
| HD-45337 | SHIFT SHAFT SEAL INSTALLER | 7.5 SHIFT SHAFT AND SEAL, Installation |
| HD-45338 | SHIFT LEVER SUBSTITUTE | 7.3 TRANSMISSION, Assembly |
| HD-45339 | SHIFT MECHANISM/DENTENT RETRACTOR | 7.3 TRANSMISSION, Disassembly |
| HD-45340 | GASKET ALIGNMENT TOOL | 1.25 VALVE LASH, Lash Adjustment |
| HD-45340 | GASKET ALIGNMENT TOOL | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| HD-45340 | GASKET ALIGNMENT DOWELS | 3.10 UPPER AND LOWER CRANKCASE SEPARATION, Disassembly |
| HD-45340 | GASKET ALIGNMENT DOWELS | 7.2 CLUTCH, Installation |
| HD-45340 | GASKET ALIGNMENT DOWELS | 8.13 ALTERNATOR, Removal |
| HD-45340 | GASKET ALIGNMENT DOWELS | 8.13 ALTERNATOR, Installation |
| HD-45490 | BALANCER BEARING REMOVER/INSTALLER TOOLS | 7.4 COUNTERBALANCER BEARING REPLACEMENT, Removal |
| HD-45490 | BALANCER BEARING REMOVER/INSTALLER TOOLS | 7.4 COUNTERBALANCER BEARING REPLACEMENT, Installation |
| HD-45491 | TAPPET COMPRESSSING TOOL | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Removal |
| HD-45491 | TAPPET COMPRESSING TOOL | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| HD-45491 | TAPPET COMPRESSING TOOL | 3.9 CYLINDER HEAD, Removal |
| HD-45653 | TDC POSITIONING TOOL | 1.25 VALVE LASH, Verify Cam Timing |
| HD-45653 | TDC POSITIONING TOOL | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Removal |
| HD-45653 | TDC POSITIONING TOOL | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| HD-45653 | TDC POSITIONING TOOL | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| HD-45654 | CLUTCH DISC ALIGNING SPACER | 7.2 CLUTCH, Assembly |
| HD-45928 | PACKARD MICRO-64 TERMINAL REMOVER | A.18 PACKARD MICRO-64 CONNECTORS, Packard Micro-64 Connector Repair |
| HD-45929 | PACKARD MICRO-64 TERMINAL CRIMPER | A.18 PACKARD MICRO-64 CONNECTORS, Packard Micro-64 Connector Repair |
| HD-46503 | OIL LINE REMOVER | 6.7 OIL LINE FITTINGS, Removal |
| HD-46503 | OIL LINE REMOVER | 6.8 RADIATOR AND OIL COOLER, Removal |

# Tools Used in This Manual

| PART NUMBER | TOOL NAME | NOTES |
|---|---|---|
| HD-46582 | COUNTERBALANCER BEARING INNER RACE REMOVER AND INSTALLER | 7.4 COUNTERBALANCER BEARING REPLACEMENT, Removal |
| HD-47175 | SWINGARM BEARING INSTALLATION TOOL | 2.38 SWINGARM, Disassembly and Assembly |
| HD-47175 | SWINGARM BEARING INSTALLATION TOOL | 2.38 SWINGARM, Disassembly and Assembly |
| HD-47176 | SWINGARM GUIDE | 2.38 SWINGARM, Installation |
| HD-47181 | ANGLE BLADE FEELER GAUGE SET | 1.25 VALVE LASH, Lash Measurement |
| HD-47189 | PISTON PIN REMOVAL AND INSTALLATION TOOL | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation |
| HD-48114 | MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER | A.11 MOLEX CONNECTORS, Molex Connector Repair |
| HD-48119 | ELECTRICAL CRIMP TOOL | A.11 MOLEX CONNECTORS, Crimp Terminal to Lead |
| HD-48625 | CLUTCH HUB HOLDER | 7.2 CLUTCH, Removal |
| HD-48625 | CLUTCH HUB HOLDER | 7.2 CLUTCH, Removal |
| HD-48625 | CLUTCH HUB HOLDER | 7.2 CLUTCH, Installation |
| HD-48650 | DIGITAL TECHNICIAN II | 1.12 BLEEDING BRAKES, Procedure |
| HD-48650 | DIGITAL TECHNICIAN II | 4.13 FUEL PRESSURE TEST, General |
| HD-48650 | DIGITAL TECHNICIAN II | C.1 ABS MODULE, Installation |
| HD-48650 | DIGITAL TECHNICIAN II | C.3 ABS BRAKE LINES, Front Master Cylinder to ABS Module |
| HD-48650 | DIGITAL TECHNICIAN II | C.3 ABS BRAKE LINES, ABS Module to Front Brake Calipers |
| HD-59000A | PRO-LEVEL OIL GAUGE | 2.33 FRONT FORK, Assembly |
| HD-8008M | CLUTCH HUB NUT | 7.2 CLUTCH, Removal |
| HD-94681-80 | SPOKE WRENCH | 2.26 TRUING LACED WHEELS, Lateral Truing |
| HD-94968-85TV | SUPER OIL | 1.23 CABLE, LINE AND FRAME INSPECTION, Cables and Hand Levers |
| HD-95599-80 | WHEEL TRUING STAND | 2.29 DISC RIM RUNOUT, Lateral Runout |
| HD-95637-46A | UNIVERSAL WEDGE ATTACHMENT | 2.34 STEERING HEAD, Cleaning and Inspection |
| HD-96333-105 | PISTON RING COMPRESSOR | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation |
| HD-99500-80 | WHEEL TRUING STAND | 2.26 TRUING LACED WHEELS, Lateral Truing |
| HD-99884-80 | TYPE E FORK OIL | 2.33 FRONT FORK, Assembly |
| HD-99953-99A | D.O.T. 4 BRAKE FLUID | 1.14 CLUTCH, Checking Clutch Fluid Level |
| PART NO. HD-45317 | ENGINE ASSEMBLY SUPPORT FIXTURE | 2.7 ENGINE REPLACEMENT, Removal |
| SNAP-ON BB200A | BASIC VACUUM BRAKE BLEEDER | 1.12 BLEEDING BRAKES, Procedure |
| SNAP-ON BB200A | BASIC VACUUM BRAKE BLEEDER | C.1 ABS MODULE, Installation |
| SNAP-ON BB200A | BASIC VACUUM BRAKE BLEEDER | C.3 ABS BRAKE LINES, Front Master Cylinder to ABS Module |
| SNAP-ON BB200A | BASIC VACUUM BRAKE BLEEDER | C.3 ABS BRAKE LINES, ABS Module to Front Brake Calipers |
| SNAP-ON CJ2001 | METRIC BOLT GRIP PULLER SET | 7.6 OUTPUT SHAFT, Disassembly - 2nd Gear End |
| SNAP-ON CJ2001 | METRIC BOLT GRIP PULLER SET | 7.6 OUTPUT SHAFT, Disassembly - 2nd Gear End |

# Tools Used in This Manual

| PART NUMBER | TOOL NAME | NOTES |
|---|---|---|
| SNAP-ON PART NO. TA360 | TORQUE ANGLE GAUGE | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation |
| SNAP-ON SDD1410 | SCREWDRIVER | 6.6 COOLANT PIPES AND HOSES, Removal |
| SNAP-ON SDD1410 | SCREWDRIVER | 6.6 COOLANT PIPES AND HOSES, Installation |
| SNAP-ON SDD1410 | LONG THIN SCREWDRIVER | 6.8 RADIATOR AND OIL COOLER, Removal |
| SNAP-ON SRPC3890 | PLIERS | 7.4 COUNTERBALANCER BEARING REPLACE-MENT, Removal |
| SNAP-ON TA360 | TORQUE ANGLE GAUGE | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation |
| SNAP-ON TA360 | TORQUE ANGLE GAUGE | 7.3 TRANSMISSION, Assembly |
| SNAP-ON TT600-3 | SNAP-ON PICK | A.15 PACKARD 630 METRI-PACK CONNECTORS, 630 Metri-Pack Connector Repair |
| TA360 | SNAP-ON TORQUE ANGLE GAUGE | 3.9 CYLINDER HEAD, Installation |

# NOTES

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| 5 mm head bolts | 86 **in-lbs** | 9.7 Nm | 3.9 CYLINDER HEAD, Installation |
| ABS module fasteners | 35-53 **in-lbs** | 4-6 Nm | C.3 ABS BRAKE LINES, Front Master Cylinder to ABS Module |
| Air bleed plug | 80-97 **in-lbs** | 9-11 Nm | 6.3 ENGINE COOLANT, Replacing Coolant |
| Air bleed plug | 80-97 **in-lbs** | 9-11 Nm | 6.5 WATER PUMP, Installation |
| Air bleed plug | 80-97 **in-lbs** | 9-11 Nm | 6.6 COOLANT PIPES AND HOSES, Installation |
| Air bleed plug | 80-97 i**in-lbs** | 9-11 Nm | 6.8 RADIATOR AND OIL COOLER, Installation |
| Air cleaner velocity stack screw | 53 **in-lbs** | 6 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Alternator cover fastener | 72-95 **in-lbs** | 8.2-10.7 Nm | 8.13 ALTERNATOR, Assembly |
| Alternator cover fastener | 86 **in-lbs** | 9.7 Nm | 8.13 ALTERNATOR, Installation |
| Auxiliary volume fasteners | 17 ft-lbs | 23 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Banjo bolt | 17-23 ft-lbs | 23-31 Nm | 2.15 SECONDARY CLUTCH ACTUATOR, Installation |
| Banjo bolt to ABS module | 12.5-14.7 ft-lbs | 17-20 Nm | C.3 ABS BRAKE LINES, Front Master Cylinder to ABS Module |
| Banjo bolt to ABS module | 13.0-14.7 ft-lbs | 17.0-20.0 Nm | C.3 ABS BRAKE LINES, ABS Module to Front Brake Calipers |
| Banjo bolt to ABS module | 12.5-14.7 ft-lbs | 17-20 Nm | C.3 ABS BRAKE LINES, Rear Master Cylinder to ABS Module |
| Banjo bolt to ABS module | 12.5-14.7 ft-lbs | 17-20 Nm | C.3 ABS BRAKE LINES, ABS Module to Rear Brake Caliper |
| Banjo bolt to calipers | 17-21.4 ft-lb | 23-29 Nm | C.3 ABS BRAKE LINES, ABS Module to Rear Brake Caliper |
| Banjo bolt to master cylinder | 12.5-14.7 ft-lbs | 17-20 Nm | C.3 ABS BRAKE LINES, Front Master Cylinder to ABS Module |
| Banjo bolt to master cylinder | 17-21.4 ft-lbs | 23-29 Nm | C.3 ABS BRAKE LINES, Rear Master Cylinder to ABS Module |
| Battery terminal | 60-96 **in-lbs** | 6.8-10.9 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Battery terminal bolt | 60-96 **in-lbs** | 6.8-10.8 Nm | 8.18 OIL PRESSURE SWITCH, Installation |
| Battery terminal bolts | 60-96 **in-lbs** | 6.8-10.8 Nm | 2.3 FRAME AND LOWER FRAME RAILS, Installation |
| Battery terminal bolts | 60-96 **in-lbs** | 6.8-10.8 Nm | 2.4 FRONT ENGINE MOUNT, Replacement |
| Battery terminal bolts | 60-96 **in-lbs** | 6.8-10.8 Nm | 2.5 FRONT ENGINE MOUNT ASSEMBLY, Installation |
| Battery terminal bolts | 60-96 **in-lbs** | 6.8-10.8 Nm | 2.6 REAR ENGINE MOUNTS, Installation |
| Battery terminal bolts | 60-96 **in-lbs** | 6.8-10.8 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Battery terminal bolts | 60-96 **in-lbs** | 6.8-10.8 Nm | 2.33 FRONT FORK, Installation |
| Battery terminal fastener | 60-96 **in-lbs** | 6.8-10.8 Nm | 6.6 COOLANT PIPES AND HOSES, Installation |
| Belt drive sprocket cover fasteners | 53-88 **in-lbs** | 6-10 Nm | 1.18 DRIVE BELT REPLACEMENT, Replacement |
| Belt drive sprocket cover fasteners | 53-88 **in-lbs** | 6-10 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Belt guard grommet bolt | 53-88 **in-lbs** | 6-10 Nm | 2.36 BELT GUARD AND DEBRIS DEFLECTOR, Installation |
| Bleeder screw | 80-100 **in-lbs** | 9-11 Nm | 2.15 SECONDARY CLUTCH ACTUATOR, Installation |
| Bleeder Screw | 80-100 **in-lbs** | 9-11 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Bleeder screws | 17.0-19.2 ft-lbs | 23.0-26.0 Nm | C.3 ABS BRAKE LINES, ABS Module to Front Brake Calipers |
| Bleeder valve | 80-97 **in-lbs** | 9.0-11.0 Nm | 1.12 BLEEDING BRAKES, Procedure |
| Bleed screw | 80-100 **in-lbs** | 9-11 Nm | 1.15 BLEEDING CLUTCH FLUID LINE, Procedure |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Bolts | 16-24 ft-lbs | 22-23 Nm | 2.24 FRONT WHEEL, Assembly |
| Brake disc bolts, rear | 30-38 ft-lbs | 41-53 Nm | 2.27 REAR WHEEL, Assembly |
| Brake light switch fasteners | 17-19 ft-lbs | 23-26 Nm | 2.20 REAR BRAKE MASTER CYLINDER: MID-MOUNT CONTROLS, Installation |
| Brake line banjo bolt | 17-19 ft-lbs | 23-26 Nm | 2.17 FRONT BRAKE CALIPER, Installation |
| Brake master cylinder cover screws | 7-11 **in-lbs** | 0.8-1.2 Nm | 2.17 FRONT BRAKE CALIPER, Installation |
| Bright hose clamp | 27-35 **in-lbs** | 3-4 Nm | 6.5 WATER PUMP, Installation |
| Bypass fastener | 25 ft-lbs | 35 Nm | 3.12 OIL PUMP, Oil Pump |
| Caliper pad pin | 75-102 **in-lbs** | 8.5-11.5 Nm | 1.11 BRAKE PADS AND DISCS, Brake Pad Replacement |
| Cam bearing caps | 86 **in-lbs** | 9.7 Nm | 1.25 VALVE LASH, Lash Adjustment |
| Cam chain tensioner | 74 ft-lbs | 100 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| Cam chain tensioner | 74 ft-lbs | 100 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| Cam cover fasteners | 86 **in-lbs** | 9.7 Nm | 1.25 VALVE LASH, Lash Adjustment |
| Cam cover fasteners | 86 **in-lbs** | 9.7 Nm | 1.25 VALVE LASH, Lash Adjustment |
| Cam cover fasteners | 86 **in-lbs** | 9.7 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing / Special method: Install in sequence: cable ties first, spark plug hole gasket second |
| Cam journal caps | 86 **in-lbs** | 9.7 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| Cam journal caps | 86 **in-lbs** | 9.7 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| Cam journal caps | 86 **in-lbs** | 9.7 Nm | 3.9 CYLINDER HEAD, Head Assembly |
| Cam journal caps | 86 **in-lbs** | 9.7 Nm | 3.9 CYLINDER HEAD, Head Assembly |
| Camshaft sprocket fasteners | 17 ft lbs | 23 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| Capscrew (footrest and control as a unit) | 22-26 ft-lbs | 30-35 Nm | 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT, Rider Footrests |
| Capscrew (footrest assembly) | 25-30 ft-lbs | 34-41 Nm | 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT, Rider Footrests |
| Capscrew (shift linkage) | 7-11 ft-lbs | 9-15 Nm | 2.9 FOOTRESTS AND FOOT CONTROLS: MID-MOUNT, Rider Footrests |
| Case fasteners | 18.4 ft-lbs | 25 Nm | 7.3 TRANSMISSION, Assembly |
| Center mounting bolt | 25-30 ft-lbs | 34-41 Nm | 2.5 FRONT ENGINE MOUNT ASSEMBLY, Installation |
| Clamp and bright clamp | 27-35 **in-lbs** | 3-4 Nm | 6.6 COOLANT PIPES AND HOSES, Installation |
| Clutch fluid line flare nut | 80-115 **in-lbs** | 9-13 Nm | 2.15 SECONDARY CLUTCH ACTUATOR, Installation |
| Clutch hub nut | 162 ft-lbs | 220 Nm | 7.2 CLUTCH, Installation |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Clutch inspection cover | 53-88 **in-lbs** | 6-10 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Clutch master cylinder/reservoir, banjo bolt | 13-14 ft-lbs | 17-20 Nm | 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation |
| Clutch master cylinder/reservoir, bleeder screw | 80-97 **in-lbs** | 9-11 Nm | 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation |
| Clutch master cylinder/reservoir, reservoir cover screws | 6-8 **in-lbs** | 0.7-0.9 Nm | 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation |
| Clutch master cylinder/reservoir, secondary clutch actuator cover mounting bolts | 53-88 **in-lbs** | 6-10 Nm | 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation |
| Clutch side crankcase cover fasteners | 86 **in-lbs** | 9.7 Nm | 7.2 CLUTCH, Installation |
| Coil fasteners | 86 **in-lbs** | 9.7 Nm | 1.22 SPARK PLUGS AND COIL, Installation |
| Coil fasteners | 86 **in-lbs** | 9.7 Nm | 4.7 THROTTLE BODY AND FUEL RAIL, Installation |
| Compensator bowl screws | 45-55 ft-lbs | 61-75 Nm | 2.27 REAR WHEEL, Assembly |
| Connecting rod caps | 20 ft-lbs | 27 Nm | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation / Tighten to torque and then tighten an additional 90° |
| Connecting rod caps | **20 ft-lbs** | 27 Nm | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation / Tighten to torque and then tighten an additional 90° |
| Coolant air bleed plug | 80-97 **in-lbs** | 9-11 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Coolant drain plug | 21-24 **in-lbs** | 2.3-2.8 Nm | 6.3 ENGINE COOLANT, Replacing Coolant |
| Cooling fan fasteners | 44-62 **in-lbs** | 5-7 Nm | 8.22 COOLING FANS, Assembly |
| Cooling system, cross member fasteners | 15-19 ft-lbs | 20-26 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Cooling system, hose worm drive clamps | 27-35 **in-lbs** | 3-4 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Cooling system, P-clamp | 53-88 **in-lbs** | 6-10 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Cooling system, pipe clamp | 57 **in-lbs** | 6.5 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Cooling system, pipe connecting clamp | 53-88 **in-lbs** | 6-10 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Cooling system, top mounting flange nuts | 15-20 ft-lbs | 19-27 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Counterbalancer gear fastener | 37 ft-lbs | 50 Nm | 7.3 TRANSMISSION, Assembly |
| Counterbalancer gear fastener | 37 ft-lbs | 50 Nm | 7.4 COUNTERBALANCER BEARING REPLACEMENT, Installation |
| Crank position sensor fastener | 73-95 **in-lbs** | 8.2-10.7 Nm | 8.12 CRANK POSITION SENSOR (CKP), Installation |
| Cross member fasteners | 15-19 ft-lbs | 20-26 Nm | 6.8 RADIATOR AND OIL COOLER, Installation |
| Cross member mounting bolts | 15-19 ft-lbs | 20-26 Nm | 2.3 FRAME AND LOWER FRAME RAILS, Installation |
| Debris deflector fastener | 53-88 **in-lbs** | 6-10 Nm | 1.18 DRIVE BELT REPLACEMENT, Replacement |
| Debris deflector fastener | 53-88 **in-lbs** | 6-10 Nm | 2.36 BELT GUARD AND DEBRIS DEFLECTOR, Installation |
| Debris deflector mounting bolt | 53-88 **in-lbs** | 6-10 Nm | 2.27 REAR WHEEL, Installation |
| Derby cover fastener | 72-95 **in-lbs** | 8.2-10.7 Nm | 8.13 ALTERNATOR, Installation |
| Drain plug | 25.8 ft-lbs | 35 Nm | 1.2 MAINTENANCE SCHEDULE, General |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Drain plug | 21-24 **in-lbs** | 2.3-2.8 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Drive sprocket cover | 53-88 **in-lbs** | 6-10 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Drive sprocket flange nut | 118 ft-lbs | 160 Nm | 1.19 DRIVE SPROCKET FLANGE, Replacement |
| Drive sprocket flange seal retainer fasteners | 17 ft-lbs | 23 Nm | 1.19 DRIVE SPROCKET FLANGE, Replacement |
| Drive sprocket flange seal retainer fasteners | 17 ft-lbs | 23 Nm | 7.3 TRANSMISSION, Assembly |
| Drive sprocket locking bolts | 65-75 ft-lbs | 88-102 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| ECT intake clamps | 11 **in-lbs** | 1.25 Nm | 4.6 ENGINE COOLANT TEMPERATURE SENSOR (ECT), Installation |
| ECT sensor | 17 ft-lbs | 23 Nm | 4.6 ENGINE COOLANT TEMPERATURE SENSOR (ECT), Installation |
| Engine crankcase end of stabilizer link | 25-30 ft-lbs | 34-41 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Engine drain plug | 86 **in-lbs** | 9.7 Nm | 2.7 ENGINE REPLACEMENT, Removal |
| Engine mount bracket bolts | 25-30 ft-lbs | 34-41 Nm | 2.5 FRONT ENGINE MOUNT ASSEMBLY, Installation |
| Engine mount bracket bolts | 25-30 ft-lbs | 34-41 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Engine mount double threaded studs | 25-30 ft-lbs | 34-41 Nm | 2.5 FRONT ENGINE MOUNT ASSEMBLY, Installation |
| Engine mount double threaded studs | 25-30 ft-lbs | 34-41 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Engine mount to bracket | 25-30 ft-lbs | 34-41 Nm | 2.5 FRONT ENGINE MOUNT ASSEMBLY, Disassembly And Assembly |
| Engine timing plug | 17 ft-lbs | 23 Nm | 1.25 VALVE LASH, Verify Cam Timing |
| Engine timing plug | 17 ft-lbs | 23 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| Exhaust clamp nut | 24-27 ft-lbs | 32-37 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Exhaust flange hex-nuts | 71-106 **in-lbs** | 8-12 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Exhaust pipe to cylinder head fasteners | 71-106 **in-lbs** | 8-12 Nm | 4.15 EXHAUST SYSTEM: VRSCD, Exhaust Pipes |
| Exhaust system support pin | 17 ft-lbs | 23 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Fender, inner fasteners | 75-81 ft-lbs | 95-110 Nm | 2.40 REAR FENDER, Installation |
| Fender bracket to front fork bolts | 15-19 ft-lbs | 20-26 Nm | 2.32 FRONT FENDER, Installation |
| Fender mounting fasteners | 40-66 **in-lbs** | 4.5-7.5 Nm | 2.40 REAR FENDER, Installation |
| Figure 8 clamp | 22-25 ft-lbs | 30-34 Nm | 4.15 EXHAUST SYSTEM: VRSCD, Installation |
| Figure 8 clamp | 22-25 ft-lbs | 30-34 Nm | 4.16 EXHAUST SYSTEM: VRSCDX, Installation |
| Flange nut | 118 ft-lbs | 160 Nm | 7.6 OUTPUT SHAFT, Disassembly - 2nd Gear End |
| Footrest axle fastener, left | 9-12 ft-lbs | 11-17 Nm | 2.8 FOOTRESTS AND FOOT CONTROLS: FORWARD MOUNT, Rider Footrests |
| Footrest axle fastener, right | 9-12 ft-lbs | 11-17 Nm | 2.8 FOOTRESTS AND FOOT CONTROLS: FORWARD MOUNT, Rider Footrests |
| Footrest bracket socket head capscrews | 14-20 ft-lbs | 19-27 Nm | 2.10 PASSENGER FOOTRESTS, Passenger Footrests |
| Fork pinch bolts | 31-34 ft-lbs | 41-47 Nm | 2.33 FRONT FORK, Installation |
| Fork stem bracket pinch bolts | 30-35 ft-lbs | 41-47 Nm | 1.21 STEERING HEAD BEARINGS, Adjustment (Fall-Away) |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Fork stem nut | 70-80 ft-lbs | 95-108 Nm | 1.21 STEERING HEAD BEARINGS, Adjustment (Fall-Away) |
| Fork stem nut | 70-80 ft-lbs | 95-108 Nm | 2.34 STEERING HEAD, Installation |
| Fork tube caps | 16-43 ft-lbs | 22-58 Nm | 2.33 FRONT FORK, Assembly |
| Front and rear oil cooler fasteners | 89-106 **in-lbs** | 10-12 Nm | 6.9 OIL COOLER, Installation |
| Front brake caliper bottom mounting bolt | 32-38 ft-lbs | 43-52 Nm | 2.17 FRONT BRAKE CALIPER, Installation |
| Front brake caliper top mounting bolt | 32-38 ft-lbs | 43-52 Nm | 2.17 FRONT BRAKE CALIPER, Installation |
| Front brake hose bracket bolt | 6-10 Nm | 53-89 **in-lbs** | 2.34 STEERING HEAD, Installation |
| Front brake master cylinder banjo bolt | 13-15 ft-lbs | 17-20 Nm | 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR, Installation |
| Front brake master cylinder cover screws | 7-11 **in-lbs** | 0.8-1.2 Nm | 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR, Installation |
| Front caliper pin | 75-102 **in-lbs** | 8.5-11.5 Nm | 1.11 BRAKE PADS AND DISCS, Brake Pad Replacement |
| Front cylinder coolant drain plug | 86 **in-lbs** | 9.7 Nm | 6.3 ENGINE COOLANT, Replacing Coolant |
| Front cylinder secondary cam chain tensioner | 74 ft-lbs | 100 Nm | 1.26 SECONDARY CAM CHAIN, Adjustment |
| Front engine coolant drain plug | 86 **in-lbs** | 9.7 Nm | 6.5 WATER PUMP, Removal |
| Front engine mount bolts | 25-30 ft-lbs | 34-41 Nm | 2.4 FRONT ENGINE MOUNT, Replacement |
| Front engine mount fastener | 28 ft-lbs | 38 Nm | 1.25 VALVE LASH, Lash Adjustment |
| Front fender bracket fasteners | 36-60 **in-lbs** | 4.1-6.8 Nm | 2.32 FRONT FENDER, Installation |
| Front wheel axle holder pinch bolt | 11 ft-lbs | 16 Nm | 2.24 FRONT WHEEL, Installation |
| Front wheel axle nut | 50-55 ft-lbs | 68-75 Nm | 2.24 FRONT WHEEL, Installation |
| Front wheel bottom mounting bolt | 32-38 ft-lbs | 43-52 Nm | 2.24 FRONT WHEEL, Installation |
| Front wheel top mounting bolt | 32-38 ft-lbs | 43-52 Nm | 2.24 FRONT WHEEL, Installation |
| Fuel injector screws | 18.0-25.0 **in-lbs** | 2.0-2.8 Nm | 4.11 FUEL INJECTORS, Assembly |
| Fuel injector screws | 18.0-25.0 **in-lbs** | 2.0-2.8 Nm | 4.11 FUEL INJECTORS, Assembly |
| Fuel injector screws | 18.0-25.0 **in-lbs** | 2.0-2.8 Nm | 4.11 FUEL INJECTORS, Assembly |
| Fuel rail bolts | 86 **in-lbs** | 9.7 Nm | 4.7 THROTTLE BODY AND FUEL RAIL, Installation |
| Fuel tank mounting fasteners | 30-35 ft-lbs | 40-48 Nm | 4.3 FUEL TANK, Installation |
| Gasket and cover fasteners | 7-11 **in-lbs** | 0.8-1.2 Nm | 2.17 FRONT BRAKE CALIPER, Installation |
| Grabstrap | 97-150 **in-lbs** | 11-17 Nm | 2.39 SEAT, Installation |
| Ground cable terminal ring nut bolt | 53-88 **in-lbs** | 6-10 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Handlebar clamp and master cylinder housing screws | 71-80 **in-lbs** | 8-9 Nm | 2.16 FRONT BRAKE MASTER CYLINDER/RESERVOIR, Installation |
| Handlebar clamp screw | 60-80 **in-lbs** | 6.8-9.0 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Handlebar clamp screw | 6.8-9.0 Nm | 60-80 **in-lbs** | 8.24 RIGHT HANDLEBAR SWITCH, Installation / T27 TORX |
| Handlebar clamp screw | 60-80 **in-lbs** | 6.8 Nm | 8.25 LEFT HANDLEBAR SWITCH, Installation / T27 TORX |
| Handlebar clamp screws | 71-80 **in-lbs** | 8-9 Nm | 2.12 CLUTCH MASTER CYLINDER AND RESERVOIR, Installation |
| Handlebar cover fasteners | 12-16 **in-lbs** | 1.3-1.9 Nm | 8.14 INSTRUMENT CLUSTER: VRSCAW, Installation |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Handlebar housing screws | 35-45 **in-lbs** | 4.0-5.1 Nm | 1.24 THROTTLE CABLES, Lubrication |
| Handlebars (VRSCAW) bolts | 31-35 ft-lbs | 41-47 Nm | 2.22 HANDLEBARS: VRSCAW, Installation |
| Handlebars (VRSCAW) lower handlebar cover fasteners | 53-88 **in-lbs** | 6-10 Nm | 2.22 HANDLEBARS: VRSCAW, Installation |
| Handlebars (VRSCAW) top handlebar cover fasteners | 12-16 **in-lbs** | 1.3-1.9 Nm | 2.22 HANDLEBARS: VRSCAW, Installation |
| Handlebars (VRSCD/VRSCDX), cast riser fasteners | 31-35 ft-lbs | 41-47 Nm | 2.23 HANDLEBARS: ALL EXCEPT VRSCAW, Installation |
| Handlebars (VRSCD/VRSCDX) clamp, front fasteners | 144-180 **in-lbs** | 16-20 Nm | 2.23 HANDLEBARS: ALL EXCEPT VRSCAW, Installation / First, tighten front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp. Second, tighten rear fasteners to torque. Third, tighten front fasteners to torque. |
| Handlebars (VRSCD/VRSCDX) clamp, rear fasteners | 144-180 **in-lbs** | 16-20 Nm | 2.23 HANDLEBARS: ALL EXCEPT VRSCAW, Installation / First, tighten front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp. Second, tighten rear fasteners to torque. Third, tighten front fasteners to torque. |
| Handlebar switch housing screw | 35-45 **in-lbs** | 4-5 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Handlebar switch housing screws | 35-45 **in-lbs** | 4.0-5.1 Nm | 8.24 RIGHT HANDLEBAR SWITCH, Installation / T25 TORX |
| Handlebar switch housing screws | 35-45 **in-lbs** | 4.0-5.1 Nm | 8.25 LEFT HANDLEBAR SWITCH, Installation / T25 TORX |
| Head bolts, initial torque | 25.8 ft-lbs | 35 Nm | 3.9 CYLINDER HEAD, Installation / Special method: See Head bolts, second torque |
| Head bolts, second torque | 14.8 ft-lbs | 20 Nm | 3.9 CYLINDER HEAD, Installation / Special method: Apply initial torque. Loosen each bolt one full turn(360°). Apply second torque. Position the Torque Angle Gauge and tighten bolt an additional 90° |
| Headlamp alignment fastener | 25-30 ft-lbs | 34-41 Nm | 1.27 HEADLAMP ALIGNMENT, Adjustment |
| Headlamp bracket fastener | 8-13 ft-lbs | 11-18 Nm | 8.14 INSTRUMENT CLUSTER: VRSCAW, Installation |
| Headlamp bracket fasteners | 9-13 ft-lbs | 11-18 Nm | 2.22 HANDLEBARS: VRSCAW, Installation |
| Headlamp bracket fasteners | 25-30 ft-lbs | 34-41 Nm | 2.23 HANDLEBARS: ALL EXCEPT VRSCAW, Installation |
| Headlamp bucket fasteners | 30-50 **in-lbs** | 3.4-5.6 Nm | 8.8 HEADLAMP: VRSCD/VRSCDX, Headlamp Bulb |
| Heat shield screws | 88 **in-lbs** | 10 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Hex-nut | 53-88 **in-lbs** | 6-10 Nm | 5.4 STARTER, Installation |
| Hex-nuts | 53-88 **in-lbs** | 6-10 Nm | 5.5 STARTER SOLENOID, Installation |
| Horn assembly acorn nut | 80-132 **in-lbs** | 9-15 Nm | 8.21 HORN, Replacement |
| Horn flange nut | 53-70 **in-lbs** | 6-8 Nm | 8.21 HORN, Replacement |
| Hose clamps | 27-35 **in-lbs** | 3-4 Nm | 6.8 RADIATOR AND OIL COOLER, Installation |
| Hose cover | 27-35 **in-lbs** | 3-4 Nm | 6.5 WATER PUMP, Installation |
| IAC screws | 25-35 **in-lbs** | 2-4 Nm | 4.8 IDLE AIR CONTROL (IAC), Installation |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Ignition/light switch fasteners | 35-62 **in-lbs** | 4-7 Nm | 8.6 IGNITION/HEADLAMP KEY SWITCH, Replacement |
| Input bearing retainer fasteners | 17 ft-lbs | 23 Nm | 7.3 TRANSMISSION, Assembly |
| Instrument cluster to housing fasteners | 12-16 **in-lbs** | 1.3-1.9 Nm | 8.15 INSTRUMENT CLUSTER: VRSCD/VRSCDX, Installation |
| Instrument housing hinge fastener | 20-24 **in-lbs** | 2.2-2.8 Nm | 8.15 INSTRUMENT CLUSTER: VRSCD/VRSCDX, Installation |
| Intake hose clamps | 11 **in-lbs** | 1.25 Nm | 4.7 THROTTLE BODY AND FUEL RAIL, Installation |
| Jiffy stand anchor | 62-79 **in-lbs** | 7-9 Nm | 2.41 JIFFY STAND, Installation |
| Locking bolts | 65-75 ft-lbs | 88-102 Nm | 1.18 DRIVE BELT REPLACEMENT, Replacement |
| Locking bolts | 65-75 ft-lbs | 88-102 Nm | 1.19 DRIVE SPROCKET FLANGE, Replacement |
| Lock nuts (2) | 25-30 ft-lbs | 34-41 Nm | 2.31 WHEEL ALIGNMENT, Centering Engine |
| Lower frame rail bolts | 45-55 ft-lbs | 61-75 Nm | 2.3 FRAME AND LOWER FRAME RAILS, Installation |
| Lower frame rail bolts | 45-55 ft-lbs | 61-75 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Lower muffler fasteners | 17 ft-lbs | 23 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Lower muffler mounting fastener | 14-20 ft-lbs | 19-27 Nm | 4.15 EXHAUST SYSTEM: VRSCD, Installation |
| Lower muffler mounting fastener | 14-20 ft-lbs | 19-27 Nm | 4.16 EXHAUST SYSTEM: VRSCDX, Installation |
| Lower volume mounting fasteners | 14-20 ft-lbs | 19-27 Nm | 4.15 EXHAUST SYSTEM: VRSCD, Installation |
| Lower volume mounting fasteners | 14-20 ft-lbs | 19-27 Nm | 4.16 EXHAUST SYSTEM: VRSCDX, Installation |
| Main bearing bolts | 18.4 ft-lbs | 25 Nm | 7.3 TRANSMISSION, Assembly / See 2-step procedure. |
| Main bearing bolts | 11 ft-lbs | 15 Nm | 7.3 TRANSMISSION, Assembly |
| MAP sensor bracket bolt | 53.0-88 **in-lbs** | 6.0-10.0 Nm | 4.9 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP), Installation |
| Master cylinder reservoir cover | 7-11 **in-lbs** | 0.8-1.2 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Muffler clamp | 22-25 ft-lbs | 30-34 Nm | 4.15 EXHAUST SYSTEM: VRSCD, Mufflers / VRSCD |
| Muffler to muffler fasteners | 17 ft lbs | 23 Nm | 4.15 EXHAUST SYSTEM: VRSCD, Mufflers |
| Negative battery cable fastener | 60-96 **in-lbs** | 6.8-10.8 Nm | 6.9 OIL COOLER, Installation |
| Negative battery fasteners | 60-96 **in-lbs** | 6.8-10.8 Nm | 6.7 OIL LINE FITTINGS, Installation |
| Negative battery fasteners | 60-96 **in-lbs** | 6.8-10.8 Nm | 6.8 RADIATOR AND OIL COOLER, Installation |
| Negative battery terminal bolt | 53-89 **in-lbs** | 6-10 Nm | 1.9 BATTERY MAINTENANCE, Installation/Connection |
| Neutral switch | 113-146 **in-lbs** | 12.8-16.5 Nm | 8.17 NEUTRAL SWITCH, Installation |
| Oil drain plug | 25.8 ft-lbs | 35 Nm | 1.8 ENGINE OIL AND FILTER, Changing Oil and Filter |
| Oil drain plug | 25 ft-lbs | 35 Nm | 2.7 ENGINE REPLACEMENT, Removal |
| Oil filter mount fasteners | 86 in-lbs | 9.7 Nm | 3.13 OIL FILTER MOUNT, Removal/Installation |
| Oil line fittings | 29-32 ft-lbs | 40-44 Nm | 6.7 OIL LINE FITTINGS, Installation |
| Oil line manifold fasteners | 71-88 **in-lbs** | 8-10 Nm | 6.9 OIL COOLER, Installation |
| Oil pan fasteners | 86 **in-lbs** | 9.7 Nm | 7.3 TRANSMISSION, Assembly |
| Oil pan gasket fasteners | 86 **in-lbs** | 9.7 Nm | 7.3 TRANSMISSION, Assembly |
| Oil pressure switch | 96-120 **in-lbs** | 10.8-13.6 Nm | 8.18 OIL PRESSURE SWITCH, Installation |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Oil pump cover fasteners | 86 **in-lbs** | 9.7 Nm | 3.12 OIL PUMP, Oil Pump / Use a crisscross pattern when tightening |
| Oil pump fasteners | 86 **in-lbs** | 9.7 Nm | 3.12 OIL PUMP, Oil Pump |
| Passenger pillion fasteners | 15-19 ft-lbs | 20-26 Nm | 2.40 REAR FENDER, Installation |
| Passenger seat mounting fastener | 97-150 **in-lbs** | 11-17 Nm | 8.11 TURN SIGNAL SECURITY MODULE (TSSM), Installation |
| P-clamp | 53-88 **in-lbs** | 6-10 Nm | 6.6 COOLANT PIPES AND HOSES, Installation |
| P-clamp | 53-88 **in-lbs** | 6-10 Nm | 6.8 RADIATOR AND OIL COOLER, Installation |
| Pillion mounting bolt | 97-150 **in-lbs** | 11-17 Nm | 2.39 SEAT, Installation |
| Pipe clamp | 57 **in-lbs** | 6.5 Nm | 6.6 COOLANT PIPES AND HOSES, Installation |
| Pipe clamp | 57 **in-lbs** | 6.5 Nm | 6.8 RADIATOR AND OIL COOLER, Installation |
| pivot shaft nut | 45-55 ft-lbs | 61-75 Nm | 2.38 SWINGARM, Installation |
| Pivot shaft nut | 45-55 ft-lbs | 61-75 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Positive battery terminal bolt | 53-89 **in-lbs** | 6-10 Nm | 1.9 BATTERY MAINTENANCE, Installation/Connection |
| Primary chain fixed tensioner fastener | 86 **in-lbs** | 9.7 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation |
| Primary chain hydraulic tensioner fastener | 86 **in-lbs** | 9.7 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation |
| Primary gear fasteners | 88 **in-lbs** | 10 Nm | 3.11 ENGINE BOTTOM END SERVICE, Crankshaft, Piston and Cylinder Liner Removal/Installation / Use a crisscross pattern when tightening |
| Radiator cover fasteners | 36-60 **in-lbs** | 4.1-6.8 Nm | 8.22 COOLING FANS, Installation |
| Radiator drain plug | 21-24 **in-lbs** | 2.3-2.8 Nm | 2.7 ENGINE REPLACEMENT, Removal / HAND TIGHTEN to torque. |
| Radiator drain plug | 21-24 in-lbs | 2.3-2.8 Nm | 6.4 THERMOSTAT, Removal |
| Radiator drain plug | 21-24 **in-lbs** | 2.3-2.8 Nm | 6.5 WATER PUMP, Removal |
| Radiator hose fasteners | 86 **in-lbs** | 9.7 Nm | 1.25 VALVE LASH, Lash Adjustment |
| Radiator oil line bracket fastener | 71-88 **in-lbs** | 8-10 Nm | 6.9 OIL COOLER, Installation |
| Radiator side cover fastener | 27-35 **in-lbs** | 3-4 Nm | 1.6 RADIATOR SIDE COVERS, Installation |
| Radiator trim cover fastener | 26-35 **in-lbs** | 3-4 Nm | 8.13 ALTERNATOR, Installation |
| Radiator trim cover fastener | 26-35 **in-lbs** | 3-4 Nm | 8.22 COOLING FANS, Installation |
| Radiator trim cover fastener | 26-35 **in-lbs** | 3-4 Nm | 8.22 COOLING FANS, Installation |
| Rear axle nut | 140-150 ft-lbs | 190-203 Nm | 1.16 REAR BELT DEFLECTION , Inspection |
| Rear axle nut | 140-150 ft-lbs | 190-203 Nm | 1.18 DRIVE BELT REPLACEMENT, Replacement |
| Rear axle nut | 140-150 ft-lbs | 190-203 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Rear axle nut | 140-150 ft-lbs | 190-203 Nm | 2.27 REAR WHEEL, Installation |
| Rear brake caliper banjo bolt | 17-19 ft-lbs | 23-26 Nm | 2.21 REAR BRAKE CALIPER, Installation |
| Rear brake caliper fastener | 43-48 ft-lbs | 58-66 Nm | 2.21 REAR BRAKE CALIPER, Removal |
| Rear brake master cylinder (Mid-Mount) set screw | (18-24 **in-lbs**) | 2-2.7 Nm | 2.20 REAR BRAKE MASTER CYLINDER: MID-MOUNT CONTROLS, Assembly |
| Rear brake master cylinder banjo bolt | 17-19 ft-lbs | 23-26 Nm | 2.18 REAR BRAKE MASTER CYLINDER AND RESERVOIR: FORWARD CONTROLS, Installation |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Rear brake master cylinder fasteners | 7-11 ft-lbs | 8-12 Nm | 2.20 REAR BRAKE MASTER CYLINDER: MID-MOUNT CONTROLS, Installation |
| Rear brake master cylinder jam nut | 30-40 ft-lbs | 41-54 Nm | 2.18 REAR BRAKE MASTER CYLINDER AND RESERVOIR: FORWARD CONTROLS, Installation |
| Rear brake reservoir cover screws | 6-8 **in-lbs** | 0.7-0.9 Nm | 2.18 REAR BRAKE MASTER CYLINDER AND RESERVOIR: FORWARD CONTROLS, Installation |
| Rear cylinder secondary cam chain tensioner | 74 ft-lbs | 100 Nm | 1.26 SECONDARY CAM CHAIN, Adjustment |
| Rear engine mount bolts | 25-30 ft-lbs | 34-41 Nm | 2.6 REAR ENGINE MOUNTS, Installation |
| Reservoir banjo bolt | 17-23 ft-lbs | 23-31 Nm | 1.15 BLEEDING CLUTCH FLUID LINE, Procedure |
| Reservoir cap screws | 6-8 **in-lbs** | 0.7-0.9 Nm | 1.11 BRAKE PADS AND DISCS, Brake Pad Replacement |
| Reservoir cap screws | 7-11 **in-lbs** | 0.8-1.2 Nm | 1.11 BRAKE PADS AND DISCS, Brake Pad Replacement |
| Reservoir cover screws | 7-11 **in-lbs** | 0.8-1.2 Nm | 1.10 BRAKES, Fluid Inspection |
| Reservoir cover screws | 6-8 **in-lbs** | 0.7-0.9 Nm | 1.14 CLUTCH, Checking Clutch Fluid Level |
| Reservoir cover screws | 6-8 **in-lbs** | 0.7-0.9 Nm | 1.15 BLEEDING CLUTCH FLUID LINE, Procedure |
| Reservoir cover screws | 6-8 **in-lbs** | 0.7-0.9 Nm | 2.15 SECONDARY CLUTCH ACTUATOR, Installation |
| Rotor nut | 60 ft-lbs | 83 Nm | 8.13 ALTERNATOR, Removal / Initial torque; see procedure |
| Rotor nut | 132 ft-lbs | 180 Nm | 8.13 ALTERNATOR, Removal / Final torque; see procedure |
| Rotor nut, initial torque | 60 ft-lbs | 82 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation / Special method: See Rotor nut, last torque. |
| Rotor nut, last torque | 132 ft-lbs | 180 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation / Special method: Apply initial torque. Loosen one full turn. Apply final torque. |
| Screw | 53.0-88.4 **in-lbs** | 6-10 Nm | C.3 ABS BRAKE LINES, ABS Module to Front Brake Calipers |
| Seat pipe screw | 106-159 **in-lbs** | 12-18 Nm | 2.33 FRONT FORK, Assembly |
| Secondary clutch actuator cover fasteners | 53-88 **in-lbs** | 6-10 Nm | 1.15 BLEEDING CLUTCH FLUID LINE, Procedure |
| Secondary clutch actuator cover fasteners | 53-88 **in-lbs** | 6-10 Nm | 2.15 SECONDARY CLUTCH ACTUATOR, Installation |
| Secondary clutch actuator cover fasteners | 53-88 **in-lbs** | 6-10 Nm | 7.2 CLUTCH, Installation |
| Secondary clutch actuator crankcase cover fasteners | 88 **in-lbs** | 10 Nm | 7.2 CLUTCH, Installation |
| Secondary clutch actuator fasteners | 88 **in-lbs** | 10 Nm | 2.15 SECONDARY CLUTCH ACTUATOR, Installation |
| Shifter arm clamp bolt | 11-12 ft-lbs | 14-16 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Shifter linkage to shifter arm bolt | 80-132 **in-lbs** | 9-15 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Shift linkage fastener | 7-11 ft-lbs | 9-15 Nm | 2.8 FOOTRESTS AND FOOT CONTROLS: FORWARD MOUNT, Rider Footrests |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| Shock mount bolt | 85-92 ft-lbs | 115-125 Nm | 2.40 REAR FENDER, Installation |
| Shock mount bolts | 31-50 ft-lbs | 41-68 Nm | 2.37 REAR SHOCK ABSORBERS, Installation |
| Side cover fastener | 36-60 **in-lbs** | 4.1-6.8 Nm | 8.4 MAXI-FUSE, Replacement |
| Solenoid bracket nuts | 53-88 **in-lbs** | 6-10 Nm | 2.3 FRAME AND LOWER FRAME RAILS, Installation |
| Solenoid cable terminal ring | 53-88 **in-lbs** | 6-10 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Spark plugs | 17 ft-lbs | 23 Nm | 1.2 MAINTENANCE SCHEDULE, General |
| Spark plugs | 17 ft-lbs | 23 Nm | 1.22 SPARK PLUGS AND COIL, Installation |
| Spark plugs | 17 ft-lbs | 23 Nm | 1.25 VALVE LASH, Lash Adjustment |
| Spark plugs | 17 ft-lbs | 23 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Installation of Cams, Timing Chains and Camshaft Timing |
| Spark plugs | 17 ft-lbs | 23 Nm | 4.7 THROTTLE BODY AND FUEL RAIL, Installation |
| Spoke nipple: 19 in. wheel | 55-65 **in-lbs** | 6.2-7.3 Nm | 2.25 WHEEL LACING, Procedure |
| Spoke nipples | 55 **in-lbs** | 6.2 Nm | 2.26 TRUING LACED WHEELS, Radial Truing |
| Spring screws | 86 **in-lbs** | 9.7 Nm | 7.2 CLUTCH, Assembly |
| Spring washers | 16-24 ft-lbs | 22-33 Nm | 2.24 FRONT WHEEL, Assembly |
| Stabilizer link and frame bracket bolt | 25-30 ft-lbs | 34-41 Nm | 2.5 FRONT ENGINE MOUNT ASSEMBLY, Installation |
| Stabilizer link and spacer bolt | 25-30 ft-lbs | 34-41 Nm | 2.5 FRONT ENGINE MOUNT ASSEMBLY, Installation |
| Stabilizer link to frame tab fastener | 25-30 ft-lbs | 34-41 Nm | 2.31 WHEEL ALIGNMENT, Centering Engine |
| Stabilizer to frame tab | 25-30 ft-lbs | 34-41 Nm | 2.3 FRAME AND LOWER FRAME RAILS, Installation |
| Starter limiter fastener | 34 ft-lbs | 46 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation |
| Starter mounting bolts | 13-20 ft-lbs | 17.6-27.1 Nm | 5.4 STARTER, Installation |
| Starter solenoid | 53-88 **in-lbs** | 6-10 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Stator mounting fastener | 72-95 **in-lbs** | 8.2-10.7 Nm | 8.13 ALTERNATOR, Assembly |
| Stoplight switch | 17-21 ft-lbs | 23-29 Nm | 8.20 STOPLIGHT SWITCH: MID-MOUNT CONTROLS, Installation |
| Thermostat air bleed plug | 80-97 **in-lbs** | 9-11 Nm | 6.4 THERMOSTAT, Installation |
| Thermostat housing fasteners | 86 **in-lbs** | 9.7 Nm | 6.4 THERMOSTAT, Installation |
| Thermostat lower hose clamp | 27-35 **in-lbs** | 3-4 Nm | 6.4 THERMOSTAT, Installation |
| Thermostat pipe clamp and p-clamp fasteners | 53-88 ft-lbs | 6-10 Nm | 6.4 THERMOSTAT, Installation |
| Throttle body clamp fasteners | 11 **in-lbs** | 1.25 Nm | 2.7 ENGINE REPLACEMENT, Installation |
| Throttle housing screws | 35-45 **in-lbs** | 4-5 Nm | 2.11 THROTTLE CABLES, Assembly and Installation |
| Top housing fastener | 20-24 **in-lbs** | 2.2-2.8 Nm | 8.15 INSTRUMENT CLUSTER: VRSCD/VRSCDX, Installation |
| Top mounting nuts | 14-20 ft-lbs | 19-27 Nm | 6.8 RADIATOR AND OIL COOLER, Installation |
| Top plate fasteners | 44-53 **in-lbs** | 5-6 Nm | 4.12 FUEL PUMP/FILTER/SENDER ASSEMBLY, Installation |
| Torque (domestic model at crank) | 82 ft-lbs | 111.2 Nm | 3.1 SPECIFICATIONS: ENGINE, General |

| FASTENER | TORQUE VALUE | | NOTES |
|---|---|---|---|
| TP sensor screws | 18-25 **in-lbs** | 2.0-2.8 Nm | 4.4 THROTTLE POSITION SENSOR (TP), Installation |
| Triple sprocket fastener | 17 ft-lbs | 23 Nm | 3.8 CAMSHAFTS, DRIVE CHAINS AND CAMSHAFT TIMING, Primary Cam Drive Installation |
| Upper and lower fasteners | 17 ft lbs | 23 Nm | 4.15 EXHAUST SYSTEM: VRSCD, Mufflers |
| Upper muffler clamp | 48 ft-lbs | 65 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Upper muffler fasteners | 17 ft-lbs | 23 Nm | 4.14 EXHAUST SYSTEM: VRSCAW, Installation |
| Valve stem nut | 12-15 **in-lbs** | 1.4-1.7 Nm | 2.30 TIRES, Installation |
| Velocity stack fasteners | 53 **in-lbs** | 6 Nm | 1.5 AIR CLEANER AND EXHAUST SYSTEM, Installation |
| Voltage regulator fastener | 53-88 **in-lbs** | 6-10 Nm | 8.5 VOLTAGE REGULATOR, Installation |
| VSS mounting fastener | 73-95 **in-lbs** | 8.2-10.7 Nm | 8.16 VEHICLE SPEED SENSOR (VSS), Installation |
| Wather pump mounting bolts | 86 **in-lbs** | 9.7 Nm | 6.5 WATER PUMP, Installation |

# NOTES

## (

(CKP) Crank Position Sensor. . . . . 8-18
(VSS) Vehicle Speed Sensor. . . . . 8-26

## 1

150 Metri-Pack Connector
Repair. . . . . A-25

## 4

480 Metri-Pack Connector
Repair. . . . . A-28

## 6

630 Metri-Pack Connector
Repair. . . . . A-29

## A

ABS Module
Installation. . . . . C-2
Removal. . . . . C-1
Removal. . . . . C-1
Removal. . . . . C-1
Removal. . . . . C-2
Removal. . . . . C-4
Removal. . . . . C-5
Removal. . . . . C-6
Airbox and Air Filter
Installation. . . . . 1-12
Removal. . . . . 1-11
Air Cleaner and Exhaust System
Exhaust System Leak Check. . . . . 1-13
Alternator
Assembly. . . . . 8-21
Disassembly. . . . . 8-20
Electrical. . . . . 8-19
General. . . . . 8-19
Installation. . . . . 8-21
Removal. . . . . 8-19
Alternator Rotor Remover (HD-45315). . . . . 8-19
AMP 1-Place Connector
Repair. . . . . A-1
AMP Multilock Connector
Repair. . . . . A-3
Autofuse Electrical Connector. . . . . A-7
Autofuse Electrical Connector. . . . . A-7
Assembly. . . . . A-7
Assembly. . . . . A-7
Disassembly. . . . . A-7

## B

Back Lash Gear Alignment. . . . . 7-10
Balancer Bearing Remover/Installer Tools (HD-45490). . 7-25
Battery
Charging Battery. . . . . 1-21
Battery Maintenance. . . . . 1-20
Cleaning and Inspection. . . . . 1-21
Disconnection/Removal. . . . . 1-21
Installation/Connection. . . . . 1-23
Storage. . . . . 1-24
Belt Guard/Debris Deflector
Installation. . . . . 2-88
Removal. . . . . 2-88
Black Light Leak Detector (HD-35457). . . . . 6-4
Bleeding Brakes
Bleeding Brakes. . . . . 1-31
General. . . . . 1-31
Bleeding Clutch Fluid Line
Procedure. . . . . 1-35
Bottom End Repair
Engine Removed from Chassis. . . . . 3-7
Brake Line (ABS)
ABS Module to Front Brake Calipers. . . . . C-5
ABS Module to Rear Brake Caliper Brake Line. . . . . C-8
Front Master Cylinder to ABS Module Brake Line. . . C-5
Rear Master Cylinder to ABS Module. . . . . C-7
Brake Pads and Discs
Brake Pad Replacement. . . . . 1-27
Inspection. . . . . 1-27
Brakes
Fluid Inspection. . . . . 1-25
Rear Brake Pedal. . . . . 1-26
Bulb Chart. . . . . 1-10
VRSC (table). . . . . 1-10
Bulb Chart (table). . . . . 1-10
Bulb Requirements
Electrical. . . . . 1-10

## C

Cable, Line and Frame Inspection
Cables and Hand Levers. . . . . 1-49
Fuel System Lines and Fittings. . . . . 1-49
General. . . . . 1-49
Hydraulic Lines. . . . . 1-49
Jiffy Stand. . . . . 1-49
Camshaft Inspection
Camshaft Spalling. . . . . 3-20
Lobe Surface Finish. . . . . 3-20
Camshafts
Installation. . . . . 3-25
Removal. . . . . 3-17
Camshaft Timing
Installation. . . . . 3-25
Camshaft Timings
Removal. . . . . 3-17
Cleaning
Bearings. . . . . 1-3
Cleaning Process. . . . . 1-3
Part Protection. . . . . 1-3
Rust or Corrosion Removal. . . . . 1-3
Clutch
Assembly. . . . . 7-7
Checking Clutch Fluid Level. . . . . 1-34
Cleaning/Inspection. . . . . 7-6
General. . . . . 1-34
Installation. . . . . 7-10
Removal. . . . . 7-2
Clutch Cover Torque Sequence. . . . . 7-2
Clutch Cover Torque Sequence. . . . . 7-10
Clutch Disc Aligning Spacer (HD-45654). . . . . 7-7
Clutch Fluid Line
Removal. . . . . 2-30
Clutch Hand Lever
Installation. . . . . 2-29
Removal. . . . . 2-29
Clutch Hub Holder (HD-48625). . . . . 7-2
Clutch Hub Holder (HD-48625). . . . . 7-7
Clutch Interlock Switch
Replacement. . . . . 8-44
Clutch Master Cylinder/Reservoir
Assembly. . . . . 2-27
Disassembly. . . . . 2-26
General. . . . . 2-26
Installation. . . . . 2-28
Removal. . . . . 2-26

Clutch Pack. . . . . 7-10
Compression Test
Performing. . . . . 3-13
Connector Locations. . . . . B-1
Conversions
Fluid. . . . . E-2
Length. . . . . E-1
Torque. . . . . E-3
Coolant & Battery Tester (HD-23688). . . . . 6-6
Coolant Flow
Description. . . . . 6-2
General. . . . . 6-2
Coolant Pipes and Hoses
Installation. . . . . 6-15
Coolant System Pressure Tester (HD-45335). . . . . 6-3
Coolant System Pressure Tester (HD-45335). . . . . 6-4
Coolant System Pressure Tester (HD-45335). . . . . 6-4
Cooling Fans
Electrical. . . . . 8-33
Installation. . . . . 8-34
Removal. . . . . 8-33
Cooling System
Check for Coolant in System. . . . . 1-16
Checking Coolant Level in Overflow Bottle. . . . . 1-16
Coolant Flow. . . . . 6-2
Cooling Pipes and Hoses. . . . . 6-13
Cooling Pipes and Hoses. . . . . 6-13
Engine Coolant. . . . . 6-6
Flow. . . . . 6-2
Leak Detection Dye Test. . . . . 6-4
Oil Cooler. . . . . 6-23
Oil Line Fittings. . . . . 6-16
Pressure Cap. . . . . 6-2
Pressure Cap Test. . . . . 6-3
Pressure Test. . . . . 6-4
Radiator/Oil Cooler. . . . . 6-18
Specifications. . . . . 6-1
Tests for Blown Gasket. . . . . 6-5
Thermostat. . . . . 6-8
Troubleshooting. . . . . 6-2
Water Pump. . . . . 6-10
Cooling System Troubleshooting
Coolant Leaks. . . . . 6-2
High Engine Temperature. . . . . 6-2
Low Engine Temperature. . . . . 6-2
Counterbalancer
Bearing Replacement. . . . . 7-25
Counterbalancer Alignment Pin (HD-45311). . . . . 7-16
Counterbalancer Alignment Pin (HD-45311). . . . . 7-25
Counterbalancer Bearing
Removal. . . . . 7-25
Counterbalancer Bearing Inner Race Remover and Installer
(HD-46582). . . . . 7-25
Counterbalancer Bearing Replacement
Installation. . . . . 7-28
Crank Position Sensor (CKP)
Electrical. . . . . 8-18
Installation. . . . . 8-18
Removal. . . . . 8-18
Crankshaft
Removal/Installation. . . . . 3-50
Crankshaft Assembly Retainer (HD-45316). . . . . 7-16
Crankshaft Locking Pin (HD-45306). . . . . 7-16
Critical Fasteners
Inspection. . . . . 1-67
Cyliinder Heads
Removal. . . . . 3-34
Cylinder Heads
Disassembly. . . . . 3-35
Head Assembly. . . . . 3-42
Installation. . . . . 3-44
Valve Seat Refacing. . . . . 3-41
Cylinder Leakage Test
Performing. . . . . 3-13
Cylinder Liner
Removal/Installation. . . . . 3-50

## D

Delphi Connector
Repair. . . . . A-8
Deutsch 1-Place Connector
Repair. . . . . A-12
Deutsch Connector
Crimping Mini Terminals. . . . . A-17
Crimping Solid Barrel Terminals. . . . . A-19
Crimping Standard Terminals. . . . . A-18
Repair. . . . . A-13
Disc Rim Runout
General. . . . . 2-72
Lateral Runout. . . . . 2-72
Radial Runout. . . . . 2-72
Drive Belt Replacement
Replacement. . . . . 1-41
Drive Sprocket Flange
Replacement. . . . . 1-43

## E

Electrical
Alternator. . . . . 8-19
Bulb Requirements. . . . . 1-10
Cooling Fans. . . . . 8-33
Crank Position Sensor (CKP). . . . . 8-18
Horn. . . . . 8-31
Ignition/Light Switch. . . . . 8-5
Ignition/Light Switch. . . . . 8-8
Instrument Cluster (VRSCAW). . . . . 8-23
Instrument Cluster (VRSCD/VRSCDX). . . . . 8-25
Left Handlebar Switch. . . . . 8-42
Maxi-Fuse. . . . . 8-5
Neutral Switch. . . . . 8-27
Oil Pressure Switch. . . . . 8-28
Relay/Fuse Block. . . . . 8-3
Right Handlebar Switch. . . . . 8-36
Specifications. . . . . 8-1
Stoplight Switch. . . . . 8-29
Stop Light Switch. . . . . 8-30
Tail Lamp. . . . . 8-13
Turn Signals/Running Lights. . . . . 8-15
Turn Signal Security Module (TSSM). . . . . 8-17
Vehicle Speed Sensor (VSS). . . . . 8-26
Voltage Regulator. . . . . 8-6
Electronic Control Module: ECM
General. . . . . 8-2
Installation. . . . . 8-2
Removal. . . . . 8-2

Electronic Fuel Injection (EFI)
Troubleshooting. . . . . 4-2
Engine
Counterbalancer Bearing Replacement. . . . . 7-25
Shift Shaft Seal Replacement. . . . . 7-32
Engine Botom End Service
Crankshaft, Piston and Cylinder Liner
Removal/Installation. . . . . 3-50
Engine Coolant
Replacing. . . . . 6-6
Engine Coolant Temperature Sensor: ECT
General. . . . . 4-8
Installation. . . . . 4-8
Removal. . . . . 4-8
Engine Cradle and Stand
Installing Engine. . . . . 3-15
Engine Oil
Grades. . . . . 1-8
Temperature Recommendations. . . . . 1-8
Winter Lubrication. . . . . 1-8
Engine Oil and Filter
Changing Oil and Filter. . . . . 1-18
Checking and Adding Oil. . . . . 1-17
Engine Replacement
General. . . . . 2-11
Installation. . . . . 2-16
Removal. . . . . 2-5
Removal. . . . . 2-11
Evap. Emissions Control: CA Models
Carbon Canister. . . . . 4-42
General. . . . . 4-41
Purge Solenoid. . . . . 4-41
Tube Routing/Replacement. . . . . 4-42
Exhaust System (VRSCAW/VRSCAWA)
Installation. . . . . 4-29
Removal. . . . . 4-27
Exhaust System (VRSCD/VRSCDA)
Exhaust Pipes. . . . . 4-32
Exhaust System (VRSCD)
Installation. . . . . 4-31
Installation. . . . . 4-36
Mufflers. . . . . 4-33
Removal. . . . . 4-30
Exhaust System (VRSCDX/VRSCDXA)
Removal. . . . . 4-35

## F

Fluid Conversions. . . . . E-2
Footrests/Controls (Forward Mounted)
Rider Footrests. . . . . 2-19
Footrests/Controls (Mid Mounted)
Rider Footrests. . . . . 2-21
Fork Lock
General. . . . . 2-87
Fork Lock (All Except VRSCR)
Installation. . . . . 2-87
Removal. . . . . 2-87
Frame/Lower Frame Rails
General. . . . . 2-5
Front Brake Calipers
Installation. . . . . 2-37
Removal. . . . . 2-37
Front Brake Master Cylinder/Reservoir
Assembly. . . . . 2-35
Cleaning and Inspection. . . . . 2-35
Installation. . . . . 2-35
Removal and Disassembly. . . . . 2-33
Front Engine Mount
Replacement. . . . . 2-7
Front Engine Mount Assembly
Disassembly And Assembly. . . . . 2-8
Installation. . . . . 2-8
Removal. . . . . 2-8
Front Fender
Installation. . . . . 2-78
Removal. . . . . 2-78
Front Fork
Removal. . . . . 2-79
Front Fork (All Except VRSCR)
Cleaning and Inspection. . . . . 2-80
Disassembly. . . . . 2-79
Installation. . . . . 2-83
Front Turn Signals
Replacement. . . . . 8-15
Front Wheel
Assembly. . . . . 2-56
Cleaning and Inspection. . . . . 2-56
Disassembly. . . . . 2-55
General. . . . . 2-53
Installation. . . . . 2-57
Removal. . . . . 2-54
Fuel and Oil
Gasoline Blends. . . . . 1-8
Fuel Injectors
Assembly. . . . . 4-18
Disassembly. . . . . 4-18
General. . . . . 4-18
Installation. . . . . 4-19
Removal. . . . . 4-18
Fuel Pressure Test. . . . . 4-25
Testing. . . . . 4-25
Fuel Pump, Filter, and Sender Assembly
Suction Side Fuel Filter. . . . . 4-22
Fuel Pump/Filter/Sender Assembly
Fuel Level Sensor. . . . . 4-24
Fuel Pump. . . . . 4-22
Installation. . . . . 4-21
Pressure Side Fuel Filter. . . . . 4-22
Removal. . . . . 4-20
Fuel System
Specifications. . . . . 4-1
Fuel Tank
Cleaning and Inspecting. . . . . 4-4
Installation. . . . . 4-4
Removal. . . . . 4-3
Fuse Block Repair. . . . . A-27
Fuse Replacement. . . . . 8-3

## G

Gasoline
Octane Ratings. . . . . 1-8
Type. . . . . 1-8
Glossary
Acronyms and Abbreviations. . . . . F-1

## H

Handlebars (VRSCAW)
Installation. . . . . 2-50
Removal. . . . . 2-49
Handlebars (VRSCD/VRSCDX)
Installation. . . . . 2-51
Removal. . . . . 2-51
Handlebar Switch (Left)
Electrical. . . . . 8-42
Handlebar Switch (Right)
Electrical. . . . . 8-36
Handlebar Switches
General Procedures. . . . . 8-35
General Repair Procedures. . . . . 8-35
Headlamp (VRSCAW). . . . . 8-9
Headlamp (VRSCD, VRSCDX). . . . . 8-11
Headlamp Alignment
Adjustment. . . . . 1-65
Inspection. . . . . 1-65
Headlamp Bulb
Remove/Install. . . . . 8-9
Remove/Install. . . . . 8-11
High Oil Consumption
Diagnosing. . . . . 3-14
Horn
Electrical. . . . . 8-31
Inspection. . . . . 8-31
Replacement. . . . . 8-31

## I

Idle Air Control. . . . . 4-13
Idle Air Control: IAC
Installation. . . . . 4-13
Removal. . . . . 4-13
Ignition/Light Switch
Replacement. . . . . 8-8
Instrument Cluster: VRSCAW
Removal. . . . . 8-23
Instrument Cluster (VRSCAW)
Electrical. . . . . 8-23
Instrument Cluster (VRSCD/VRSCDX)
Electrical. . . . . 8-25
Intake Air Temperature Sensor: IAT
Installation. . . . . 4-6
Removal. . . . . 4-6
Intake Air Temperature Sensor (IAT). . . . . 4-6
Intake Leak Test
General. . . . . 4-39
Leak Tester: Parts List. . . . . 4-39
Leak Tester: Tester Adjustment. . . . . 4-39
Leak Tester: Tester Assembly. . . . . 4-39
Procedure. . . . . 4-39

## J

Jiffy Stand
Cleaning. . . . . 2-99
Installation. . . . . 2-100
Interlock. . . . . 2-99
Removal. . . . . 2-99

## L

Lamp Replacement. . . . . 8-15
Left Handlebar Switch
Assembly. . . . . 8-44
Disassembly. . . . . 8-43
Installation. . . . . 8-42
Removal. . . . . 8-42
Switch Repair/Replacement. . . . . 8-43
Light Bulbs
Replacement. . . . . 1-10
Light Switch, Ignition Switch
Electrical. . . . . 8-5
Electrical. . . . . 8-8
Loctite. . . . . i-II
Lower Crankshaft Alignment Dowels (HD-45310). . . . . 7-16

## M

Maintenance Schedule
General. . . . . 1-5
Manifold Absolute Pressure Sensor: MAP
Installation. . . . . 4-14
Removal. . . . . 4-14
Maxi-Fuse
Electrical. . . . . 8-5
Maxi-Fuse Housing
Repair. . . . . A-10
Metric System. . . . . E-2
Metri-Pack Terminals
Crimping. . . . . A-30
Molex Connector
Repair. . . . . A-21
Terminal Crimps. . . . . A-22

## N

Neutral Switch
Electrical. . . . . 8-27
Installation. . . . . 8-27
Removal. . . . . 8-27

## O

Octane Rating. . . . . 1-8
Oil Cooler. . . . . 6-23
Installation. . . . . 6-23
Removal. . . . . 6-23
Oil Filter Mount
Removal/Installation. . . . . 3-66
Oil Flow
General. . . . . 3-8
Oil Line Fittings. . . . . 6-16
Installation. . . . . 6-17
Removal. . . . . 6-16
Oil Pressure
Checking. . . . . 3-12
Oil Pressure Indicator Lamp
General. . . . . 3-12
Oil Pressure Switch
Electrical. . . . . 8-28
Installation. . . . . 8-28
Removal. . . . . 8-28
Oil Pump
Replacement. . . . . 3-64
Output Shaft
General. . . . . 7-34
Transmission. . . . . 7-34

Oxygen Sensor
Installation. . . . . 4-16
Installation. . . . . 4-16
Removal. . . . . 4-15

## P

Packard 100W Connector
Repair. . . . . A-32
Packard Micro-64 Connector
Repair. . . . . A-34
Passenger Footrests
Passenger Footrests. . . . . 2-23
Piston
Removal/Installation. . . . . 3-50
Primary Cam Drive
Installation. . . . . 3-23
Removal. . . . . 3-22

## R

Radiator/Oil Cooler
Installation. . . . . 6-20
Removal. . . . . 6-18
Radiator/Oil Cooler 20. . . . . 6-18
Radiator Side Covers
Installation. . . . . 1-15
Removal. . . . . 1-14
Rear Belt and Sprockets. . . . . 1-39
Cleaning. . . . . 1-39
Inspection. . . . . 1-39
Rear Belt Deflection
Inspection. . . . . 1-37
Rear Brake Caliper
Installation. . . . . 2-48
Removal. . . . . 2-48
Rear Brake Master Cyl./Res. (Fwd. Controls)
Assembly. . . . . 2-41
Cleaning and Inspection. . . . . 2-41
Disassembly. . . . . 2-41
Installation. . . . . 2-42
Removal. . . . . 2-39
Rear Brake Master Cylinder (Mid-Controls). . . . . 2-45
Cleaning and Inspection. . . . . 2-46
Removal. . . . . 2-44
Rear Brake Reservoir (Mid-Controls)
Assembly. . . . . 2-46
Installation. . . . . 2-43
Removal. . . . . 2-43
Rear Engine Mounts
Installation. . . . . 2-10
Removal. . . . . 2-10
Rear Fender
Installation. . . . . 2-98
Removal. . . . . 2-98
Rear Shock Absorbers
Adjustment. . . . . 1-45
General. . . . . 1-45
Installation. . . . . 2-89
Removal. . . . . 2-89
Rear Turn Signals, Replacement. . . . . 8-16
Rear Wheel
Assembly. . . . . 2-67
Cleaning and Inspection. . . . . 2-67
Disassembly. . . . . 2-66
General. . . . . 2-64
Installation. . . . . 2-67
Removal. . . . . 2-65
Relay, Fuse Block
Electrical. . . . . 8-3
Relay/Fuse Block
Installation. . . . . 8-3
Removal. . . . . 8-3
Relay Replacement. . . . . 8-3
Repair and Replacement Procedures
Bearings. . . . . 1-2
Bushings. . . . . 1-2
Exhaust System Leakage. . . . . 1-3
Gaskets. . . . . 1-2
Gears. . . . . 1-3
Hardware and Threaded Parts. . . . . 1-2
Lip Type Seals. . . . . 1-2
O-Rings (Preformed Packings). . . . . 1-3
Part Replacement. . . . . 1-3
Shafts. . . . . 1-3
Threadlocking Agents. . . . . 1-2
Wiring, Hoses and Lines. . . . . 1-2
Right Handlebar Switch
Assembly. . . . . 8-41
Disassembly. . . . . 8-38
Installation. . . . . 8-36
Removal. . . . . 8-36
Switch Repair/Replacement. . . . . 8-39
Robinair Heat Gun (HD-25070). . . . . 6-15
Rotor. . . . . 8-19

## S

Safe Operating Maintenance. . . . . 1-1
Sealed Splice. . . . . A-37
Sealed Wheel Bearings
General. . . . . 2-69
Inspection: Lateral End Play. . . . . 2-69
Removal. . . . . 2-69
Seat
Removal. . . . . 2-96
Seat (All Except VRSCR)
Cleaning and Inspection. . . . . 2-96
Installation. . . . . 2-96
Secondary Cam Chain
Adjustment. . . . . 1-62
General. . . . . 1-62
Secondary Clutch Actuator
Assembly. . . . . 2-31
Installation. . . . . 2-31
Removal. . . . . 2-31
Service Bulletins. . . . . i-I
Service Preparation. . . . . i-I
Service Wear Limits
Engine (All except VRSCX). . . . . 3-5
Servicing a New Motorcycle. . . . . 1-1
Shift Drum
Removal. . . . . 7-14
Shift Lever Substitute (HD-45338). . . . . 7-16
Shift Mechanism/Detent Retractor (HD-45339). . . . . 7-16
Shift Shaft
Seal Replacement. . . . . 7-32
Shift Shaft and Seal
General. . . . . 7-32

Installation. . . . . 7-33
Removal. . . . . 7-32
Shop Practices. . . . . 1-1
Checking Torques. . . . . 1-2
Cleaning. . . . . 1-1
Disassembly and Assembly. . . . . 1-2
Magnetic Parts Trays. . . . . 1-2
Removing Parts. . . . . 1-1
Safety. . . . . 1-1
Smoking Engine
Diagnosing. . . . . 3-14
Spark Plug and Coil
General. . . . . 1-47
Installation. . . . . 1-48
Removal/Inspection. . . . . 1-47
Specifications
Engine (All except VRSCX). . . . . 3-1
Fuel System. . . . . 4-1
General. . . . . 2-1
SPX Kent-Moore. . . . . i-II
Starter
Electric Starter System. . . . . 5-2
Installation. . . . . 5-5
Relay. . . . . 5-4
Removal. . . . . 5-5
Specifications. . . . . 5-1
Starter Relay
Installation. . . . . 5-4
Removal. . . . . 5-4
Starter Solenoid
General, Removal, Installation. . . . . 5-6
Installation. . . . . 5-6
Removal. . . . . 5-6
Starting Circuit Schematic. . . . . 5-2
Steering Head
Assembly. . . . . 2-86
Cleaning and Inspection. . . . . 2-85
Installation. . . . . 2-86
Removal. . . . . 2-84
Steering Head Bearings
Rear Shock Preload. . . . . 1-46
Stoplight Switch
Electrical (Forward Mount Controls). . . . . 8-29
Installation. . . . . 8-30
Removal. . . . . 8-29
Removal. . . . . 8-30
Replacement. . . . . 8-40
Stop Light Switch
Electrical (Mid-Mount Controls). . . . . 8-30
Installation. . . . . 8-29
Storage
General. . . . . 1-68
Placing In Storage. . . . . 1-68
Removal from Storage. . . . . 1-68
Stripping Motorcycle for Service
General. . . . . 3-15
Swingarm
Disassembly and Assembly. . . . . 2-92
Installation. . . . . 2-94
Removal. . . . . 2-91

## T

Tail Lamp
Electrical. . . . . 8-13
Installation. . . . . 8-13
Removal. . . . . 8-13
Thermostat. . . . . 6-8
Installation. . . . . 6-8
Removal. . . . . 6-8
Thermostat Removal Tool. . . . . 6-8
Thermostat Removal Tool (HD-45307). . . . . 6-8
Throttle Body and Fuel Rail
Installation. . . . . 4-10
Removal. . . . . 4-10
Throttle Cables
Adjustment. . . . . 1-50
Assembly and Installation. . . . . 2-24
Cleaning And Inspection. . . . . 2-24
Lubrication. . . . . 1-50
Removal/Disassembly. . . . . 2-24
Throttle Position Sensor: TP
Installation. . . . . 4-5
Removal. . . . . 4-5
Throttle Position Sensor (TP)
General. . . . . 4-5
Timing Chains
Installation. . . . . 3-25
Removal. . . . . 3-17
Tire Replacement
Inspection. . . . . 2-73
When To Replace. . . . . 2-73
Tires
Cleaning, Inspection, and Repair. . . . . 2-73
General. . . . . 2-73
Installation. . . . . 2-74
Removal. . . . . 2-73
Wear Bar Indicators. . . . . 2-73
Tires and Wheels
Tires. . . . . 1-33
Wheel Bearings. . . . . 1-33
Tool Safety
Air Tools. . . . . 1-3
Hammers. . . . . 1-4
Pliers/Cutters/Pry bars. . . . . 1-3
Punches/Chisels. . . . . 1-4
Ratchets and Handles. . . . . 1-4
Screwdrivers. . . . . 1-4
Sockets. . . . . 1-4
Storage Units. . . . . 1-4
Wrenches. . . . . 1-3
Top End Repair
Engine in Chassis. . . . . 3-7
Torque Conversion. . . . . E-3
Trademarks
Harley-Davidson. . . . . i-II
Referenced Products. . . . . i-II
Transmission
Assembly. . . . . 7-16
Disassembly. . . . . 7-13
Input Shaft. . . . . 7-44
Input Shaft Assembly (1st gear end). . . . . 7-49
Input Shaft Assembly (2nd gear end). . . . . 7-47
Input Shaft Disassembly (1st gear end). . . . . 7-48

Input Shaft Disassembly (2nd gear end). . . . . 7-44
Output Shaft. . . . . 7-34
Output Shaft Assembly (1st gear end). . . . . 7-41
Output Shaft Assembly (2nd gear end). . . . . 7-39
Output Shaft Disassembly (2nd gear end). . . . . 7-34
Shift Drum Removal. . . . . 7-14
Specifications. . . . . 7-1
Transmission Assembly Retainer Tool (HD-45301). . . . . 7-16
Troubleshooting
Brakes. . . . . 1-72
Cooling System. . . . . 6-2
Electrical System. . . . . 1-71
Engine. . . . . 1-70
General. . . . . 1-70
Handling. . . . . 1-72
Lubrication System. . . . . 1-71
Transmission. . . . . 1-71
Truing Laced Wheel
General. . . . . 2-62
Radial Truing. . . . . 2-62
Truing Laced Wheels
Lateral Truing. . . . . 2-62
Turn Signal/Running Light Bulb
Replacement. . . . . 8-15
Turn Signals
Front Replacement. . . . . 8-15
Rear Replacement. . . . . 8-16
Turn Signals/Running Lights
Electrical. . . . . 8-15
Turn Signal Security Module (TSSM)
Electrical. . . . . 8-17
Installation. . . . . 8-17
Removal. . . . . 8-17
Turn Signal Switch Replacement
Left. . . . . 8-40
Right. . . . . 8-44
Typical Symptoms
Need for Engine Repair. . . . . 3-7

## U

Upper and Lower Crankcase Separation
Disassembly. . . . . 3-46

## V

V.I.N.
Vehicle Identification Number. . . . . 2-3
Valve Lash
Camshaft Inspection. . . . . 1-54
Lash Adjustment. . . . . 1-56
Lash Measurement. . . . . 1-51
Verify Cam Timing. . . . . 1-55
Valve Lash Calculation Worksheet 1
Worksheet 1. . . . . D-2
Valve Lash Calculation Worksheet 2
Worksheet 2. . . . . D-3
Valve Seat
Refacing. . . . . 3-41
Valve Tappet Shims
Tables. . . . . D-1
Valve Train Noise
Diagnosing. . . . . 3-13
Vapor Valve. . . . . 4-38
Replacement. . . . . 4-38
Vehicle Identification Number (V.I.N.). . . . . 2-3
Vehicle Speed Sensor (VSS)
Electrical. . . . . 8-26
Installation. . . . . 8-26
Removal. . . . . 8-26
Voltage Regulator
Electrical. . . . . 8-6
Installation. . . . . 8-6
Removal. . . . . 8-6

## W

Water Pump. . . . . 6-10
Installation. . . . . 6-11
Removal. . . . . 6-10
Wheel alignment
Centering Engine. . . . . 2-76
Wheel Alignment
General. . . . . 2-75
Inspection. . . . . 2-75
Verification. . . . . 2-75
Wheel Lacing
19 In. Rim. . . . . 2-58
Wheel Speed Sensor, Front
Installation. . . . . 2-56
Installation. . . . . C-3
Removal. . . . . C-3
Wheel Speed Sensor, Rear
Installation. . . . . C-4
Removal. . . . . C-4
Winter Lubrication. . . . . 1-8
Wiring Diagrams. . . . . B-3

# NOTES

# INSIDE BACK COVER GOES HERE

# OUTSIDE BACK COVER GOES HERE